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ERRATA

Page 64 line 31 for "**26** 264" read "**26** 246"

„ 153 line 11 delete "the time of"

„ 153 18 lines from end after "C^{14} (radioactive carbon)" insert "per gm."

„ 172 line 12 for "liee" read "lice"

COMMONWEALTH INSTITUTE OF ENTOMOLOGY.

REVIEW
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SERIES B.

Vol. 39. 1951.

ROAN (C. C.), FERNANDO (H. E.) & KEARNS (C. W.). **A radiobiological Study of four organic Phosphates.**—*J. econ. Ent.* **43** no. 3 pp. 319–325, 1 graph, 3 refs. Menasha, Wis., 1950.

The following is based on the authors' summary and conclusions. TEPP (tetraethyl pyrophosphate), tetraisopropyl pyrophosphate, tetra-n-butyl pyrophosphate and O,O-diethyl O-paranitrophenyl phosphate were synthesised from radioactive phosphorus and used in studies employing the techniques of radiobiological assays. In a test designed to determine the effect of four solvents, dioxane, benzene, propylene glycol and ethyl alcohol, on the rates of penetration of the phosphates into the body of *Periplaneta americana* (L.) following topical applications on the ventral cervical membrane, penetration of TEPP after 60 minutes was greatest in dioxane and progressively less in propylene glycol, ethyl alcohol and benzene ; that of tetraisopropyl pyrophosphate was greatest in ethyl alcohol and progressively less in propylene glycol, dioxane and benzene ; and those of the other two phosphates were greatest in propylene glycol and progressively less in ethyl alcohol, dioxane and benzene. Following topical applications of propylene-glycol solutions, the distribution throughout the body was most rapid for TEPP and progressively less so for tetraisopropyl pyrophosphate, tetra-n-butyl pyrophosphate and O,O-diethyl O-paranitrophenyl phosphate ; this closely parallels the order of solubility in water of these materials. TEPP was excreted from the body the most rapidly and tetra-n-butyl pyrophosphate, tetraisopropyl pyrophosphate and O,O-diethyl O-paranitrophenyl phosphate progressively less so.

Experiments to determine the tissue concentration of radioactive TEPP or its metabolite after topical application showed that the highest concentrations occurred in the fore gut, with the concentration in the body fluid rising rapidly at first and then falling sharply ; slight increases were noted in muscle tissue during the first hour after treatment. After both sublethal and lethal administrations, the fore gut showed a marked selective absorption of TEPP or its metabolites and a rapid secretion of it into the gut lumen. Comparison of concentrations of TEPP in the tissues of surviving and prostrate cockroaches showed considerably higher concentrations of radioactive material in the fore gut of surviving than of prostrate cockroaches and higher concentrations in the muscles of prostrate than of surviving ones.

Although no radioactive materials were detected in the central nervous system, the authors do not consider that this necessarily indicates a complete

83) Wt. P2701/3853 3/51 S.E.R. Ltd. Gp. 432. [B] A

absence of such materials from this region, since the specific activity of the tracer compound employed had deteriorated to a rather low level when the experiment was performed.

LINDQUIST (A. W.) & ROTH (A. R.). **Effect of Dichlorodiphenyl Dichloroethane on Larvae of the Clear Lake Gnat in California.**—*J. econ. Ent.* **43** no. 3 pp. 328–332, 2 refs. Menasha, Wis., 1950.

The following is almost entirely based on the authors' summary and discussion. A lake 46 acres in extent (Lower Blue Lake) in west central California was sprayed from a boat on 7th November 1947 with an emulsified xylene solution of DDD (dichlorodiphenyldichloroethane) at a rate to give 1 part DDD to 45 million parts water, for the control of *Chaoborus astictopus* Dyar & Shann., the larvae of which remain in the bottom mud during the day and move up in the water at night. The number of larvae per 36 sq. ins. was reduced from 88 to 0 within 96 days. In 288–536 days, the larval population had increased to a maximum of only 0·55 per 36 sq. ins., although a good source of reinfestation existed only 800 ft. away. Chironomid larvae were practically eliminated 13 days after treatment, but a strong recovery was evident after 288 days. Oligochaeta and *Culicoides* were not reduced in numbers.

In October 1948, a reservoir in the same county, with an area of 65 acres, was sprayed with the same emulsion to give 1 part DDD to 75 million parts water and coverage was deliberately incomplete. In 35 days, more than 99 per cent. of the *Chaoborus* larvae were eliminated, and none could be found 194 days after treatment. The DDD had mixed thoroughly with the water in two days. The Chironomid population was eliminated, but Oligochaeta were not injured. No dead or affected fish were seen during the observations in the reservoir.

The tests indicate that *Chaoborus* larvae can be greatly reduced in numbers or eliminated in small lakes, and the second indicates that even poor coverage with a low dosage will result in adequate dispersal. On the basis of laboratory tests and other information, it is thought that treatment would be more effective if carried out in late August or early September, when water temperatures at night range from 70 to 75°F., since 90–95 per cent. of the larvae leave the bottom mud at such temperatures, as compared with about 50 per cent. at 65°.

FURMAN (D. P.) & KURTPINAR (H.). **Residual Toxicity of Chemicals for Black Widow Spider Control.**—*J. econ. Ent.* **43** no. 3 pp. 343–347, 2 refs. Menasha, Wis., 1950.

Laboratory and field tests of sprays to leave toxic deposits in corrugated metal and concrete hangars were made for the control of *Latrodectus mactans* (F.) in California. Methoxy-DDT (methoxychlor) at 0·25 per cent. in a water suspension was found to be relatively ineffective in laboratory screening tests, in which individual spiders were sprayed with 1 cc. liquid, and it was eliminated. In laboratory tests of deposits in which the spiders were exposed for 24 hours, toxaphene, DDD (dichlorodiphenyldichloroethane) and aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] were relatively ineffective, as they failed to give kills after four weeks at 150 mg. per sq. ft. Technical BHC (benzene hexachloride) containing 12 per cent. γ isomer, lindane [containing at least 99 per cent. γ BHC] and chlordan were fairly effective at the same deposit, giving kills for 8, 10 and 8 weeks, but not as persistent as DDT, which was effective for over 16 weeks [but *cf. R.A.E.*, B **34** 85]. Lindane remained effective for the same period at 18 mg. per sq. ft. and a temperature of 5°C. [41°F.] as at 150 mg. per sq. ft. and room temperature (16–33°C. [60·8–91·4°F.]). In the hangars, in which wall beams and the junctions of wall and

floor and of ceiling and wall were treated with wettable-powder sprays, lindane at 18 mg. and DDT at 100 mg. per sq. ft. gave effective control and protection from reinfestation for over 12 weeks and 6 weeks, respectively, when observations were terminated.

Blanton (F. S.), Travis (B. V.), Smith (N.) & Husman (C. N.). **Control of Adult Mosquitoes in Alaska with Aerial Sprays.**—*J. econ. Ent.* **43** no. 3 pp. 347–350, 3 refs. Menasha, Wis., 1950.

Tests in Alaska to determine whether mosquitos would fly in abundance from surrounding unsprayed areas into plots treated from aeroplanes [*cf. R.A.E.*, B **38** 52] were continued in 1949 in forested subarctic areas and in treeless tundra, and several DDT formulations at various dosages were evaluated. The materials and methods used are described. The tests involved more than 400 sq. miles, and most of them were made with a standard spray containing 20 per cent. DDT, 20 per cent. fuel oil and 60 per cent. aromatic hydrocarbon solvent applied at 0·1 lb. DDT per acre. A large-scale spray test for control of the larvae [see next abstract] showed that adults infiltrated into a treated area 10 miles square within three days of their emergence in adjacent untreated areas. When the same area was sprayed about a week after emergence to control adults, infiltration was sufficiently great to require another application in about two weeks, and this is not considered economic. Frequent treatment of small areas is believed to be more promising. In a tundra region with an extremely high mosquito population, adults infiltrated into an area covering 24 sq. miles within 19 hours of spraying. The area that would have to be sprayed to give protection in tundra is not known but would presumably be too large to be practicable. Formulation studies on plots 4 sq. miles in area indicated that a 20 per cent. DDT spray applied from an aeroplane was improved by the use of spreaders or emulsifiers. The tests confirmed that 0·1 lb. DDT is a practical dosage and that nothing is to be gained by diluting the 20 per cent. spray to 5 per cent. When spraying was done at night, more spray reached the ground and results were consequently better than when it was done by day.

Travis (B. V.), Applewhite (K. H.) & Smith (N.). **Control of Mosquito Larvae in Alaska with DDT.**—*J. econ. Ent.* **43** no. 3 pp. 350–353, 2 refs. Menasha, Wis., 1950.

In tests in 1949 against mosquito larvae in Alaska, 0·1 lb. DDT per acre applied from an aeroplane as a 20 per cent. spray in oil and solvent [see preceding abstract] was highly effective and gave slightly higher mortalities than 0·05 lb. per acre. Sprays containing either 1 per cent. Triton B-1956 (polyglyceride of a glyptal resin) as a spreader or 10 per cent. Triton X-100 (monoisooctyl phenyl polyethylene glycol ether) as an emulsifier were slightly more effective than the solution without these additions at the lower dosage. A spray diluted to 5 per cent. DDT was slightly less effective than the undiluted one at 0·1 lb. DDT per acre but rather more effective at 0·05 lb.

One year after routine applications of spray totalling 0·3 lb. DDT per acre in two areas, there were 86–99 per cent. fewer larvae in the treated marshes than in adjacent untreated ones. The residues on many small plots treated in the autumn of 1947 or the spring of 1948 [*R.A.E.*, B **38** 101–102] were still effective in the spring of 1949. Nearly all the large larvae transferred to one of these plots that had been treated with 2 lb. DDT per acre in fuel oil in August 1947 died in 48 hours. Sedge plots treated with 0·5 and 1 lb. DDT per acre by aeroplane in the autumn of 1948 showed 97 and 99 per cent. reduction in mosquito larvae, respectively, in the spring of 1949. Plots similarly treated in environments of scrub birch and *Myrica* or moss, heath and *Myrica* showed little or no reduction in populations of larvae.

Applewhite (K. H.) & Smith (C. N.). **Field Tests with Mosquito and Sand Fly Repellents in Alaska.**—*J. econ. Ent.* **43** no. 3 pp. 353–357, 1 ref. Menasha, Wis., 1950.

An account is given of field tests of repellents against mosquitos and *Culicoides* in Alaska in June and July 1948, some of the results of which have already been noticed [*R.A.E.*, B **38** 102]. Six of ten repellents applied as 25 per cent. solutions in alcohol to the skin of the forearm at 1 ml. solution per arm were effective for 113 minutes or more against *Aëdes flavescens* (Müll.) and nine for 34 minutes or more against *A. excrucians* (Wlk.), *A. communis* (Deg.) and *A. pionips* Dyar. Propyl N,N-diethylsuccinamate was the most effective against *A. flavescens*, giving protection for more than 178 minutes, whereas the other five were about equal. This material, dimethyl phthalate, 2-ethyl-1,3-hexanediol and the 6 : 2 : 2 mixture of dimethyl phthalate, 2-ethyl-1,3-hexanediol and Indalone were the most effective against the mixed population. In a comparison of three mixtures of repellents, one consisting of dimethyl phthalate, propyl N,N-diethylsuccinamate, Indalone and 2-ethyl-1,3-hexanediol (6 : 4 : 2 : 2) repelled *Aëdes* mosquitos for 189 minutes and was better than the others and also than propyl N,N-diethylsuccinamate alone.

Cream preparations containing 20 per cent. of the ten repellents were slightly less effective than 25 per cent. concentrations of the repellents applied as liquids. A proprietary cream stated to contain 41·4 per cent. dimethyl phthalate, 13·8 per cent. dimethyl carbate (dimethyl ester of cis-bicyclo [2.2.1]-5-heptene-2,3-dicarboxylic acid), 13·8 per cent. Indalone, 30 per cent. zinc stearate and 1 per cent. bentonite appeared to be about as repellent as the 6 : 2 : 2 mixture. In tests with 35 materials used to impregnate fabric at 3 gm. per sq. ft., ten were found effective against mosquitos after four rinsings and 16 hours of wear. Hexyl mandelate withstood 13 rinsings in one test and 40 hours of wear. Four of the repellents effective against mosquitos were applied at 2 gm. per sq. ft. to face masks of cotton netting but failed to give adequate protection from *Culicoides*, of which the predominant species was *C. tristriatulus* Hoffman.

Radeleff (R. D.) & Bushland (R. C.). **Acute Toxicity of Chlorinated Insecticides applied to Livestock.**—*J. econ. Ent.* **43** no. 3 pp. 358–364, 2 refs. Menasha, Wis., 1950.

Investigations undertaken in view of reports that young calves had died as a result of being dipped in emulsified solutions of toxaphene in Texas showed that calves are much more susceptible to toxaphene poisoning than are mature cattle. Further tests were therefore made of the effects on young calves of all the chlorinated hydrocarbons that had previously appeared harmless to older animals [*R.A.E.*, B **37** 235]. They were applied either very thoroughly as sprays at low pressure or by dipping. Sprays containing 8 per cent. DDT, methoxy-DDT (methoxychlor) or DDD (2,2-bis(p-chlorophenyl)-1,1-dichloroethane), all applied as suspensions of wettable powders or in emulsified xylene, caused no symptoms of poisoning, but suckling calves were particularly susceptible to BHC (benzene hexachloride), toxaphene and chlordan.

Toxaphene was studied in particular detail. It was tested as xylene and kerosene emulsion concentrates and as a 40 per cent. wettable powder. It appeared that toxaphene dips were no more likely to cause inhalation pneumonia than ordinary water. Ingestion of 50 mg. per kg. was toxic (though 25 mg. was not), the action of emulsion being more rapid than that of the suspension, and the xylene emulsion being fatal. The same concentration affected adult goats, and 100 mg. affected or killed adult sheep. Applied as sprays to suckling calves, 8 per cent. toxaphene in emulsions was fatal, 1 per

cent. in xylene emulsion was fatal to one of 11 calves and 1·5 per cent. was toxic when applied twice in suspension or emulsion. Eight applications of 0·75 per cent. toxaphene in emulsion affected only one out of 12 calves. This indicates that the chemical can be repeatedly used at a concentration slightly below that likely to produce toxic symptoms without cumulative toxic effects. The concentration needed to control engorged female ticks is about 0·5 per cent. In tests of sprays on adult animals, one steer out of seven was affected by 4 per cent. toxaphene in xylene emulsion, as was the only one treated with 8 per cent. Goats were killed by 8 per cent. in emulsion applied as a dip and affected by the same concentration in suspension but apparently unaffected by 4 per cent. Sheep were affected by 4 per cent. in emulsion, and 8 per cent. in emulsified kerosene was fatal.

Limited experiments with chlordan on young calves indicated it to be of the same order of toxicity as toxaphene, and calves were much more susceptible to BHC (benzene hexachloride) than pigs, kids or lambs. Sprays containing as little as 0·05 per cent. γ isomer sometimes proved fatal, whether they were emulsified solutions or suspensions. Toxicity seemed to depend almost entirely on the γ isomer. Workers making field tests have sprayed or dipped several hundred suckling calves in γ BHC at concentrations ranging from 0·025 to 0·03 per cent. without noting ill effects.

The symptoms and pathology of poisoning from chlorinated hydrocarbons are described, and ways in which accidental poisoning of livestock may occur during their use in the field are mentioned. Extreme care in the use of toxaphene, BHC and chlordan, especially on young calves, is recommended.

LAAKE (E. W.). **Screw-worm Survey in western United States, 1949.**—*J. econ. Ent.* **43** no. 3 pp. 387–389. Menasha, Wis., 1950.

The annual survey of *Callitroga hominivorax* (Coq.) (*americana* (Cush. & Patt.)) [*cf. R.A.E.*, B **38** 118] was continued in 1949 in most of the western States usually affected. The results for the various districts are given. The area of winter survival in Texas was larger and extended further north than usual, and the surviving population was greater than during any other winter since 1943, when the survey was begun, notwithstanding the lowest winter temperatures recorded during that time. It appeared that this survival further north than usual was due to periodical warm spells that occurred during the winter at times when they were critical for adult activity and the continuation of the life-cycle. Combined with frequent and abundant precipitation later in the year, it resulted in one of the most destructive infestations of domestic animals experienced in Texas for many years. One of the worst outbreaks seen since the survey started occurred in South Dakota as a result of the importation of possibly not more than two infested animals from Texas. Ways of stopping the importation of infested animals into the north-central States, which otherwise would not become infested, are under consideration.

ROGERS (A. J.) & MILLS (T. W.). **Spinose Ear Tick in Florida.**—*J. econ. Ent.* **43** no. 3 pp. 392–393, 1 ref. Menasha, Wis., 1950.

Otobius megnini (Dugès) was found in Florida in 1912 on horses imported from New Mexico in the previous year and was subsequently occasionally observed on cattle imported from Texas, but there was no evidence of its establishment until the spring of 1949, when 12 nymphs were collected from about 17 cows and calves belonging to a herd that had been in Alachua since 1943 and one larva was found in the ear of a dog on the same premises. The owner of the herd applied control measures during the summer, but three nymphs were found on a bull in October and one adult in the barn, though seven cows and

calves were not infested. It is concluded from the history of the herd that the tick was introduced into it with cattle imported from Texas in 1943 and had been established in Florida ever since. Little is known as to the possible spread of infestation from the Alachua herd.

NELSON (R. H.), GERSDORFF (W. A.) & MITLIN (N.). **Relative Toxicity to House Flies of DDT, Methoxychlor, and Dichlorodiphenyl Dichloroethane.**—*J. econ. Ent.* **43** no. 3 pp. 393–394, 6 refs. Menasha, Wis., 1950.

An account is given of studies undertaken to determine the relative toxicity to *Musca domestica* L. of space sprays of methoxy-DDT (methoxychlor), DDD (dichlorodiphenyldichloroethane) and DDT in kerosene. Chemically pure compounds were used in all tests. Literature on their relative effectiveness in experiments against various insects is reviewed. In this work, comparisons were made by the Campbell turntable method [*R.A.E.*, B **26** 246], and the results for four concentrations of each insecticide are given in a table. It is concluded on the basis of median lethal concentrations that DDD and methoxy-DDT are only 25 and 60 per cent. as toxic as DDT, respectively. Knockdown, however, was greatest for methoxy-DDT [*cf.* **33** 120], and greater for DDD than for DDT. The initial paralysis caused by these compounds is not equal to the complete immobilisation that results from exposure to pyrethrum sprays. Since the three compounds have rather similar molecular weights, their relative potency on a molecule-to-molecule basis is similar to that determined from the weight-volume data.

The Tentative N.A.I.D.M. Aerosol Test Method for Flying Insects.—*Soap & sanit. Chem.* **25** no. 5 pp. 114–117, 6 refs. New York, N. Y., 1949.

A description is given of a tentative procedure developed on the basis of two series of co-operative tests carried out in 1947 and 1948 by federal and industrial laboratories in the United States for making practical tests of liquefied gas aerosols against *Musca domestica* L. So far as possible, it follows the official Peet-Grady Test Procedure for both large and small groups [*R.A.E.*, B **37** 5, 89, etc.]. The reference insecticide is the Tentative Official Test Aerosol (TOTA), which must be dispensed from the container in which it is supplied. An experimental formulation may be dispensed from any container, but the results for it apply only to the particular unit used. The flies must be 3–6 days old with an average age of four days and the strain such that the OTI [*cf.* **37** 5] will cause 30–55 per cent. mortality in 24 hours and about 95 per cent. paralysis in ten minutes after application by the Peet-Grady method. Specifications for the various items of apparatus are given, together with instructions for rearing and handling the flies.

Tests are made at 82±2°F., and all windows must be equally shaded. After the flies have been liberated in the chamber, 4 gm. aerosol mixture per 1,000 cu. ft. is applied in a continuous flow. The chamber is closed for 15 minutes, and the numbers of flies paralysed after exposure for 5 and 10 minutes are recorded. After 15 minutes, the chamber is opened and ventilated with the exhaust fan, while the flies are collected. Paralysed flies are kept in clean cages with a supply of sugar solution for a recovery period of 24 hours. Unparalysed flies are counted and discarded or kept. The method of assembling data and conditions for official valuation are given. The data may be recorded as test mortality or test knockdown mortality, in which the number of all flies that die in 24 hours or the number of those paralysed in 15 minutes that do so is expressed as a percentage of the total number of flies, or as the percentage knockdown after exposure for 5, 10 or 15 minutes. The unknown is described as " meeting

the standard " if it gives an average mortality and knockdown greater than or within 5 per cent. of that caused by the TOTA tested in conjunction with it. Neither numerical values nor letter grades may be assigned.

KNIPLING (E. F.). **DDT Developments. Further Light on recent DDT Failures against the House Fly—DDT Bans discussed.**—*Soap & sanit. Chem.* **25** no. 7 pp. 107, 109, 111, 131. New York, N.Y., 1949.

Since the Food and Drug Administration of the United States has pronounced that the presence of DDT in milk will be considered contrary to the provisions of the Food, Drug and Cosmetic Act, the Bureau of Entomology and Plant Quarantine has changed its recommendations for the use of DDT for fly control not only on dairy cows but also in dairy barns and in other places where milk is handled. The ways in which treatment of barns might lead to contamination of milk are discussed. Investigations with DDT and DDD (TDE) [dichlorodiphenyldichloroethane] indicate that direct contamination of feeding stuffs, troughs and drinking vessels can readily lead to ingestion by cows and consequent contamination of milk when the insecticide is applied in accordance with common practice. Milk from cows in three barns in Texas that had been sprayed without covering the troughs, though care was taken not to treat the troughs directly, contained 0·5–1·5 parts DDT per million on the second day. Milk from cows in a fourth barn that had been similarly treated but in which the troughs had been cleaned with water from a hose after spraying contained 0·1 p.p.m. When the feed troughs were covered but the front was left unprotected, 0·5 p.p.m. DDT was found in milk on the second day. No significant amount of DDT was detected in the milk from herds in barns in which troughs and stanchions and walls near them were completely covered before spray was applied. A test in which the walls and ceilings of a barn, the floor of which was protected from contamination, were treated with 200 mg. DDT per sq. ft. from a wettable powder suspension and a cow was kept in a pen in the barn for six consecutive nights indicated that inhalation can be eliminated as a source of DDT in milk. No information is available on the importance of direct contamination of milk or milking utensils. These results suggest that it would be possible to treat dairy barns with DDT and similar insecticides in such a way as to avoid contamination of the milk.

Investigations on strains of house-flies [*Musca domestica* L.] that are resistant to DDT and other insecticides are reviewed [*cf. R.A.E.*, B **38** 203]. Reference is made to investigations indicating that there is a tendency for strains to lose their resistance to DDT when the flies are not exposed to it for several generations, though the extent of loss in resistance is extremely variable [*cf.* **38** 156, 159]. Results are also given of preliminary field tests made in Florida with various insecticidal deposits, mostly in dairy barns where flies were numerous and where unsatisfactory results with DDT had been reported. In general, methoxy-DDT (methoxychlor) at 200 mg. per sq. ft., chlordan at 100 or 200 mg. and γ BHC (benzene hexachloride) at 25 or 50 mg. greatly reduced the fly populations for several weeks after treatment, and compound 497 [dieldrin (1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene)] at 50 mg. was also promising, whereas results with DDT were variable and generally unsatisfactory. Deposits from sprays of pyrethrins and piperonyl butoxide were useless. It is not anticipated that the better compounds will have long-lasting effects comparable with those formerly obtained with DDT. The Bureau's new recommendations for control in barns are briefly reviewed. They comprise strict sanitation, use of insecticides to leave toxic deposits (preferably DDT if this has continued to give good control) in places where flies congregate outside dairy barns and milk rooms, use of

methoxy-DDT to give toxic deposits in dairy barns, supplemented by space sprays of pyrethrum and synergist if necessary, and finally screening.

HARRIS (H. J.), HANSENS (E. J.) & ALEXANDER (C. C.). **Determination of DDT in Milk produced in Barns sprayed with DDT Insecticides.**—*Agric. Chem.* **5** no. 1 pp. 51–52, 5 refs. Baltimore, Md., 1950.

The following is based on the authors' introduction and summary. In view of a report that DDT could be found in milk as a result of the application of the insecticide to dairy barns, and of a recommendation by the United States Department of Agriculture that the use of DDT sprays for controlling insects in dairy barns should be discontinued [*cf.* preceding abstract], an investigation on the chemical composition of milk from cows housed in barns sprayed with DDT was carried out in New Jersey in 1949. Four dairy barns were sprayed with DDT suspensions ; the cows were removed during the applications, food troughs and drinking fountains were protected from the spray, and food was either removed or protected. Three of the barns had also been sprayed with DDT in 1948. A visible blue colour, which would positively indicate the presence of DDT in the analytical method used, was not found in any of the samples taken twice before and five times after application, but seven of the 28 samples showed spectrophotometric evidence of containing 0·03–0·05 part DDT per million. One of them was taken before spraying in 1949 and came from a barn that had been sprayed in 1948. Four of the others came from the barn in which the least sanitary milk-handling methods were followed. It is concluded that when good dairy practices are followed, barn sprays applied with simple precautions are not likely to result in milk contamination.

BURGESS jr. (B. F.). **Surface Film Studies on DDT-Oil Larvicides.**—*Soap & sanit. Chem.* **25** no. 8 pp. 127, 129, 131, 3 refs. New York, N.Y., 1949.

An account is given of tests of various petroleum oils and surface-active agents carried out with a view to improving the stability and spreading coefficients of DDT solutions for the control of Anopheline larvae. Film pressures were determined with a hydrophil balance at 27°C. [80·6°F.]. When applied at the rate of 1 U.S. gal. per acre, none of 16 samples of oils containing 1 per cent. DDT produced a detectable surface pressure on the balance without a surface-active agent. When 0·5 per cent. Triton B-1956 was added, measurable differences of spreading pressure and stability were obtained, and four of the oils formed continuous surface films with high spreading pressures, the best being kerosene. When 0·5 per cent. surface-active agent was added to kerosene containing 1 per cent. DDT, six of the agents tested gave continuous films with high spreading pressures. In tests of the four best oils in all combinations with the four best spreading agents, kerosene with 1 per cent. DDT and 0·5 per cent. Ethofat 142/20 produced the film with the highest spreading pressure. It was stable and was shown in tests against Anopheline larvae in artificial containers to be highly effective. A knockdown of 50 per cent. of larvae was obtained 15 minutes after application of the solution at 1 U.S. gal. per acre and complete kill in 45 minutes. The surface film was continuous and uniform and satisfactorily penetrated biological films occurring on streams and ponds [*cf. R.A.E.*, B **31** 216]. Kerosene containing 1 per cent. DDT and 0·5 per cent. Triton B-1956 gave only 30 per cent. mortality after 45 minutes. Although Triton B-1956 produced a stable film when tested with the balance, immediate lens formation with uneven distribution of film was observed when it was applied to larger areas, and it could not disrupt biological film or penetrate surface débris uniformly.

LEHMAN (A. J.). **Toxic Actions of Insecticides.**—*Soap & sanit. Chem.* Blue Book 1949 pp. 173–175. New York, N.Y., 1949.

This is a review of information on the toxicity to mammals, mainly man, of derris, pyrethrum, nicotine, aliphatic thiocyanates (Lethanes), DDT, methoxy-DDT (methoxychlor), DDD [dichlorodiphenyldichloroethane], chlordan, benzene hexachloride, toxaphene, tetraethyl pyrophosphate and parathion.

HERTIG (M.). **A new Genus of bloodsucking Psychodids from Peru (Diptera : Psychodidae).**—*Ann. ent. Soc. Amer.* **41** no. 1 pp. 8–16, 14 figs., 2 refs. Columbus, Ohio, 1948.

A description is given of both sexes of *Warileya phlebotomanica*, gen. et sp. n., a Psychodid closely allied to *Phlebotomus*, of which numerous examples were collected in houses, caves and pig-pens and on walls in the Rimac Valley, Peru, in the course of studies on the epidemiology of verruga [caused by *Bartonella bacilliformis*]. Like *P. peruensis* Shannon, it is limited to the upper part of the verruga zone [*cf. R.A.E.*, B **31** 83], and there is no evidence as to any part it may play in transmitting the disease. Many females caught in caves and houses contained red blood, and at least two were observed to bite man in nature and several were fed on man in the laboratory. Attempts to induce oviposition failed. Very few males were seen.

ABDEL-MALEK (A.). **Plant Hormones (Auxins) as a Factor in the Hatching of *Aedes trivittatus* (Coquillett) Eggs.**—*Ann. ent. Soc. Amer.* **41** no. 1 pp. 51–57, 6 refs. Columbus, Ohio, 1948.

Aëdes trivittatus (Coq.) breeds in temporary pools and passes the winter in the egg stage. As it was observed in Ohio that these pools contain much plant growth, particularly blue-grass (*Poa sylvestris*) and *Festuca nutans*, and the first-instar larvae usually appear in them immediately after rain, it was thought that the grasses may have some influence on hatching [*cf. R.A.E.*, B **27** 231–232 ; **30** 40]. The following is based on the author's summary of this account of experiments on the subject, in which surface-sterilised eggs were used and none hatched in distilled water. Infusions of blue-grass caused the eggs to hatch, even after elimination of the micro-organisms from the infusion by filtering through a Berkfeld filter, but not after subjection to a temperature of 120°C. [248°F.] under 15 lb. pressure. Water solutions of three substances known to promote growth in plants (α-naphthaleneacetic acid, γ-3-indole butyric acid and indole acetic acid) brought about hatching, each at a definite concentration range. These ranges were 10–20, 2–15 and 4–13 parts per million, respectively.

BRENNAN (J. M.). **Preliminary Report on some organic Materials as Tick Repellents and toxic Agents.**—*Publ. Hlth Rep.* **62** no. 32 pp. 1162–1165, 2 refs. Washington, D.C., 1947.

A summary is given of the results of the evaluation of 15 organic materials for repellency and toxicity to ticks. The work was done in Montana. The criterion for repellency was the number of ticks seen on untreated socks as compared with the number on socks impregnated with 2 ml. liquid or 2 gm. solid per sq. ft. when the socks were worn by subjects exposed for 15 minutes to adults and nymphs of *Amblyomma americanum* (L.) and adults of *Dermacentor andersoni* Stiles under simulated natural conditions. The observations extended over a period of four weeks after treatment, but no tests were made during the third week.

Little protection against *D. andersoni* was afforded by dibenzyl, benzyl benzoate, dimethyl phthalate or 2-propyl-5-methyl-5-nitro-m-dioxane, and somewhat more, but still insufficient, protection by N-ethylacetanilide, dibutyl phthalate and the 6 : 2 : 2 mixture of dimethyl phthalate, Indalone and Rutgers 612 [2-ethyl-1, 3-hexanediol]. N-n-butylacetanilide, ethyl cyclohexylcyanoacetate, technical 2-phenyl cyclohexanol,1-benzyl cyclohexanol-1 and diethyl hexahydrophthalate gave more than 90 per cent. protection for two weeks after treatment, but, except butylacetanilide, showed a considerable reduction in effectiveness after the fourth week. Ethyl cyclohexylcyanoacetate gave complete protection when freshly applied, as did butylacetanilide the second week after treatment.

The same 12 repellents and also isopropyl cinnamate, N-n-propylacetanilide and p-n-propoxybenzaldehyde were tested against adults of *A. americanum*, and all except dibenzyl, isopropyl cinnamate and ethylacetanilide gave 95–100 per cent. protection for four weeks following treatment ; four gave complete protection throughout, and six gave 99–100 per cent. protection. All materials gave a persistently high degree of protection against nymphs of *A. americanum*, but none protected completely. The repellency of most of the materials was lost or greatly reduced after rinsing in warm tap water, but dibutyl phthalate, phenyl cyclohexanol, benzyl benzoate and butylacetanilide continued to give adequate protection from *A. americanum*, though not from *D. andersoni*.

None of the same materials, when tested for toxicity against larvae, nymphs, and adults of *D. andersoni* by confining them to squares of cloth impregnated at 4 ml. liquid or 4 gm. solid per sq. ft., immobilised adults within two hours. Three materials, including phenyl cyclohexanol, immobilised larvae in less than 15 minutes, and five others, including butylacetanilide, in less than 30 minutes. Nymphs were immobilised by phenyl cyclohexanol in 34 minutes, but butylacetanilide did not stop them within two hours. The results of limited field tests with phenyl cyclohexanol and dibutyl phthalate were consistent with those obtained from the repellent tests under simulated field conditions.

None of the materials stains fabrics. The ten that were tested for irritant properties could safely be used. A comparison of the results from all tests suggests that phenyl cyclohexanol and butylacetanilide are very promising agents against *D. andersoni* and *A. americanum*.

PRINCE (F. M.) & WAYSON (N. E.). **Addendum to : Plague—the Survival of the Infection in Fleas or hibernating Ground Squirrels.**—*Publ. Hlth Rep.* **62** no. 32 pp. 1167–1168. Washington, D.C., 1947.

Results obtained in an experiment on the survival of plague in hibernating ground squirrels (*Citellus richardsonii*) and fleas (*Diamanus montanus* (Baker)) [*R.A.E.*, B **38** 38] were confirmed in 1946–47 in a further experiment with *C. townsendii* and the same species of flea, and additional results were obtained. Four ground squirrels survived four months in hibernation after intracutaneous inoculation with plague when hibernation had begun. One remained well for six days after awaking, but died of plague on the eighth day. The other three continued well and appeared normal at necropsy when killed 15 days later. At the time these ground squirrels were inoculated, 50 normal fleas were placed on each. At the end of hibernation, 42 of the 200 were recovered alive and none was infected. In the second part of the experiment, 50 infected fleas were placed on each of four hibernating ground squirrels and left with them for four months. At the end of this period, 47 were recovered alive and four contained the infection. One of these transmitted plague to a white rat on which it was placed, two others died without feeding, and the fourth fed on five mice but did not transmit the infection.

Johnson (H. A.) & Goodman (W. L.). **DDT in Oil as a Mosquito Larvicide.**—*Publ. Hlth Rep.* **62** no. 33 pp. 1191–1198, 4 refs. Washington, D.C., 1947.

The following is substantially the authors' summary. Preliminary tests in Arkansas in 1944 indicated that kerosene containing 1·25 per cent. DDT is toxic to larvae of *Anopheles quadrimaculatus* Say when applied at 2–4 U.S. gals. per acre. Kerosene with or without the DDT was ineffective at less than 2 U.S. gals. per acre. In field tests in 1946, No. 2 fuel oil with a spreader and also kerosene were used as the vehicles for DDT. The fuel oil and spreader without DDT gave only 0–76 per cent. mortality with coverage up to 2 U.S. gals. per acre, and 1–4 U.S. gals. with 25–50 gm. DDT per acre gave 58–93 per cent. The same solution applied as a wind-borne atomised spray gave unequal kills of 75–81 per cent. in a swathe up to 25 ft. from the line of liberation. None of these results was considered satisfactory. The best larvicide tested was a kerosene solution atomised at 3 U.S. gals. kerosene and 75 gm. DDT per acre, which gave about 95–100 per cent. kill up to 40 ft. from the line of release and was simple to apply. The additional cost of kerosene over fuel oil is unimportant in comparison with the saving in labour costs when 5 U.S. gals. or less per acre can be applied. It is possible that a lower concentration of DDT in kerosene would be adequate. There was no visible evidence of damage to fish.

Erickson (A. B.). **Effects of DDT Mosquito Larviciding on Wildlife. Part II. Effects of Routine Airplane Larviciding on Bird and Mammal Populations.**—*Publ. Hlth Rep.* **62** no. 35 pp. 1254–1262, 4 graphs, 3 refs. Washington, D.C., 1947.

Bishop (E. L.). **Part III. The Effects on the Plankton Population of Routine Larviciding with DDT.**—*T. c.* pp. 1263–1268, 1 pl., 4 figs., 1 ref.

These two papers belong to a series [*R.A.E.*, B **38** 58] and refer to work done in 1945–46 in South Carolina and in 1945 in Georgia, respectively. In the investigation described in the first, 20 per cent. DDT in a highly methylated naphthalene was applied as a spray or thermal aerosol at 0·1 lb. DDT per acre weekly from aircraft over a period of 17 weeks to 815 acres of river with islands and dykes. The treatment had no harmful effect on birds or small mammals in the area.

The detrimental effect upon the plankton organisms of smaller ponds of DDT as used in dusts or oil solutions at 0·05–0·2 lb. DDT per acre for the control of larvae of *Anopheles quadrimaculatus* Say was indicated by the studies dealt with in the second paper to be so slight in comparison with the variations due to climatic and other ecological factors as to be relatively unimportant in disturbing the biological balance. A few groups showed a slight reduction in number in the treated ponds as compared with the control, but in no instance were they markedly affected.

Eklund (C. M.), Parker (R. R.) & Lackman (D. B.). **A Case of Q Fever probably contracted by Exposure to Ticks in Nature.**—*Publ. Hlth Rep.* **62** no. 39 pp. 1413–1416, 2 refs. Washington, D.C., 1947.

A case of Q fever is described in which the likely source of infection was contact with ticks (*Dermacentor andersoni* Stiles) in nature in Montana. The patient removed many ticks from his clothes and crushed them with his fingers, but he is not known to have been bitten by ticks. Diagnosis was made by complement fixation and agglutination tests and by animal inoculation.

Pratt (H. D.). **Relation of Plants to Malaria Control in Puerto Rico.**—*Publ. Hlth Rep.* Suppl. no. 200, 38 pp., 10 figs., 3 graphs, 11 refs. Washington, D.C., 1947.

The author describes the principal plant communities found associated with Anopheline larvae in Porto Rico, notes certain plants that tend to inhibit Anopheline breeding or are favourable to it, gives data on the rate of regrowth of plants in malaria control ditches, and on grasses useful in bank sodding, and discusses sand bar formation and bay production. A key to aquatic and semiaquatic plants found in Porto Rico and a catalogue of the plant species with their English and Spanish names are appended.

Cole (L. C.) & Koepke (J. A.). **Problems of Interpretation of the Data of Rodent-ectoparasite Surveys.**—*Publ. Hlth Rep.* Suppl. no. 202 pp. 1–24, 3 graphs, 38 refs. Washington, D.C., 1947. **A Study of Rodent Ectoparasites in Honolulu.**—*T. c.* pp. 25–41, 1 map, 8 refs. **A Study of Rodent Ectoparasites in Savannah, Georgia.**—*T. c.* pp. 42–59, 1 map, 9 refs. **A Study of Rodent Ectoparasites in Dothan, Alabama.**—*T. c.* pp. 61–71, 1 map, 7 refs.

The value of counts of ectoparasites from rats in studies of the epidemiology of the diseases that they carry, such as plague and murine typhus, is shown in the first paper to rest on the uniformity of the samples and on treatment of the data obtained to make an index adequately representative of the population. The sample must be as uniform as possible as regards the species of ectoparasites and hosts and also the age and habitats of the hosts and the trapping methods used ; the size of the host population should be taken into account.

Fleas on rats show a " contagious " type of distribution, *i.e.*, a tendency for large numbers to be concentrated on a few hosts. This non-random distribution restricts the range of statistical procedures that may be used in analysing the data. An efficient index should be representative of the population and vary in direct proportion to changes in it. It has not yet been demonstrated that any of the possible types is entirely adequate, but several commonly used ones are discussed. These are indices such as the " *cheopis*-rate " or ratio of *Xenopsylla cheopis* (Roths.) to total fleas, which are affected by the numbers of non-vector as well as of vector species and are therefore very inefficient ; the " mean " [*R.A.E.*, B **35** 10], with which there is a tendency to underestimate populations that are contagiously distributed ; the " infestation rate " [*loc. cit.*], which may change with change in distribution of the population, even in a constant population, and becomes useless when the population is high ; Rumreich's index (ectoparasite index), in which provision is made for the reduction of exceptionally large counts [*loc. cit.*] ; and the mean number of females of *X. cheopis* per rat [**36** 144]. Comparison of the seasonal variability of several indices showed that the mean varied most. Some advantage is gained by excluding unusually high counts and a similar advantage by excluding male fleas. The mean computed only for infested rats seems to have a decided advantage over the other indices, and omitting the male fleas in this computation slightly increases stability and gives the most promising index.

It is shown that temperature data can be used to give better than chance results in predicting *X. cheopis* indices even over short periods, but the higher counts that occur on warmer days are due to an increase in the proportion of total fleas on the hosts, not an increase in the actual size of the population. Samples taken under different conditions are therefore not comparable. The extent to which two samples are comparable can be estimated from the sex ratio [**36** 144].

The reports on surveys of ectoparasites of rodents in Honolulu (Hawaii), Savannah (Georgia) and Dothan (Alabama) that comprise the second, third and fourth papers are further intracommunity analyses of data similar to two already noticed [**35** 10 ; **37** 121]. The arrangement largely follows that of the earlier ones, the tables are comparable, including the meteorological data, and the same constants are used in statistical analysis.

In Honolulu [*cf.* **36** 190], hosts were collected on 282 days between 9th January 1934 and 5th January 1935. In addition to rats, 65 mice (*Mus musculus*) and 157 mongooses (*Herpestes*) were taken. The mice harboured only four ectoparasites, but the mongooses harboured six lice, 24 mites and 1,063 fleas, of which 839 were *Ctenocephalides felis* (Bch.), 208 *Echidnophaga gallinacea* (Westw.) and 16 *X. cheopis*. The rats taken comprised 4,967 of *Rattus norvegicus*, 1,238 of *R. rattus*, including *R. r. alexandrinus*, and 459 of *R. hawaiiensis*. Infestation rates are based on 6,382 rats collected alive. The fleas from all of them and the lice and mites from 666 were identified. Of the fleas, 16,169 were *X. cheopis*, 12 *X. hawaiiensis* Jordan, 24,676 *E. gallinacea* and 539 *C. felis*, and six belonged to other species. Of the mites, 5,971 were *Laelaps hawaiiensis* Ewing, 525 *Echinolaelaps echidninus* (Berl.) and 28 *Liponyssus bacoti* (Hirst), with six others. Of the Anoplura, 1,971 were *Polyplax spinulosa* (Burm.) and 409 *Hoplopleura* spp. In species composition, the collection differed strikingly from those at Jacksonville [**35** 10] and Mobile [**37** 121].

The monthly and annual numbers, means and infestation rates of all fleas and of the three chief species separately, with Rumreich's index and the mean number per infested rat for *X. cheopis*, are given in tables for each and all of the three species of rats and discussed. Similar data are given for mites and Anoplura for the three hosts combined, the supplementary indices being included for *Laelaps hawaiiensis*. As temperature is practically constant throughout the year in Honolulu, though rainfall varies, the year was not divided into warm and cold periods as in the previous surveys but into wet (August–January) and dry (February–July) periods. Cases of endemic typhus in man are most numerous between September and December. Only *L. hawaiiensis* was more abundant during the wet part of the year than the dry. *C. felis* and *X. cheopis* tended to be predominantly dry-weather species [*cf.* **36** 190]. Coefficients of correlation between Honolulu ectoparasite indices on *R. norvegicus* and *R. rattus* and meteorological data are given in a table. They are of a much lower order than those obtained at Jacksonville and Mobile. Abundance of *X. cheopis* or *L. hawaiiensis* was not significantly correlated with temperature, but temperature was significantly correlated with the sex ratio of *X. cheopis* as in other communities [**36** 144]. Counts of *X. cheopis* on *R. rattus* showed positive correlation with rainfall. It is concluded that at Honolulu, the climate has little effect on ectoparasite abundance. A special study would be needed to evaluate the effect of rainfall, on account of the great local variation over extremely small areas.

X. cheopis was generally most abundant in the commercial zone and in food-handling establishments and was slightly more so near residences than near business establishments not handling food, but the differences were much less definite than those found at Mobile [**37** 122]. Rats remote from buildings had significantly fewer *X. cheopis* than those in or near buildings. *Echidnophaga gallinacea* was significantly more abundant in the residential than in the commercial or water-front zones, and there were more fleas of this species on *R. norvegicus* in residences than business premises. Fewer rats caught remote from buildings were infested with *E. gallinacea* than rats in or near buildings, although the mean numbers per rat were nearly as great. *L. hawaiiensis* was least abundant in the water-front zone and was significantly more abundant on rats trapped indoors or far from buildings than on those near buildings.

In Savannah, hosts were collected alive on 617 days between 1st January 1932 and 30th December 1933. Those taken in 1932 and (in brackets) 1933 comprised 6,174 (2,547) individuals of *R. norvegicus*, 446 (131) of *R. rattus*, including *R. r. alexandrinus*, and 44 (21) of *Sigmodon hispidus*. Infestation rates are based on 5,242 individuals of *Rattus* taken alive in 1932 and 2,571 in 1933. The fleas, lice and mites from all of them were identified. The numbers taken in 1932 and (in brackets) in 1933, were 64,202 (13,302) *X. cheopis*, 18,083 (6,750) *E. gallinacea*, 17,365 (4,061) *Leptopsylla segnis* (Schönh.), 3,436 (896) *Nosopsyllus fasciatus* (Bosc), 658 (145) *C. felis*, 93 (3) *Rhopalopsyllus gwyni* Fox, 7 (0) *Pulex irritans* L., 32,747 (19,489) *Laelaps hawaiiensis*, 4,922 (499) *Echinolaelaps echidninus*, 33,496 (20,715) *Liponyssus bacoti*, 287 (87) *Atricholaelaps glasgowi* (Ewing), 581 (242) *Myobia* spp., 220 (162) Cheyletids, 192 (192) Uropodids, 750 (716) other mites, mostly unidentified, 37,961 (15,363) *Polyplax spinulosa*, 44 (16) *Hoplopleura* spp. and 25 (8) unidentified lice.

The monthly and annual numbers, means and infestation rates of all fleas and of the four chief species separately, with the adjusted indices of *X. cheopis*, for the two species of rats and both years are given in tables and discussed, together with the monthly numbers, means and infestation rates for both years and the combined host species for *Laelaps hawaiiensis*, *Liponyssus bacoti* and *Polyplax spinulosa*, the supplementary indices for *Laelaps hawaiiensis*, and the monthly numbers of *E. echidninus*, other mites, and other lice. Host specificity was much more definite than that found in the earlier studies of this series. *Rattus norvegicus* was significantly more heavily parasitised than *R. rattus* by every important species except *Leptopsylla segnis*, though infestation rates varied less than means. *Echidnophaga gallinacea* and *Liponyssus bacoti* did not differ significantly in abundance between somewhat arbitrarily defined cold and warm seasons. Only *X. cheopis* and *Laelaps hawaiiensis* were consistently associated with the warmer weather and *N. fasciatus* and *Leptopsylla segnis* and to some extent *P. spinulosa* with cold. The survey years were similar and typical as to temperature, but both, and particularly 1933, were erratic with regard to precipitation and relative humidity. *X. cheopis*, *N. fasciatus* and *L. segnis* showed consistently significant correlations, positive only in the case of *X. cheopis*, with mean daily temperature in both years. *E. gallinacea* showed significant negative correlation with relative humidity for 1932 but not 1933. *Liponyssus bacoti* showed no significant correlations. *Laelaps hawaiiensis* was inconsistent. *P. spinulosa* was negatively correlated with temperature in both years. Local variations in ectoparasite abundance were mainly in the means rather than the infestation rates. *X. cheopis*, *N. fasciatus*, *L. hawaiiensis* and *Liponyssus bacoti* tended to be prominent in the commercial zone. Both indices for *E. gallinacea* and *P. spinulosa* were low in the water-front zone. All species except *E. gallinacea* gave higher mean counts indoors than out. Means for all species were higher in food-handling establishments than other buildings. Savannah has a relatively high incidence of endemic typhus, but this is evidently not associated with any peculiar qualitative features of the rodent ectoparasite population. *L. bacoti*, which has transmitted typhus in the laboratory [**20** 49], was more abundant in Savannah than in the other cities surveyed, but showed no seasonal variations in abundance characteristic of typhus. The probability of finding a particular ectoparasite on a rat in Savannah tended to be independent of the species of rat and of the situation in which it was trapped, but the total number of parasites on an infested rat varied with environmental conditions. The apparent independence of frequency and abundance among all the species of ectoparasites seems to be the unique feature of the Savannah data.

At Dothan, the only city surveyed that is not a seaport, hosts were collected on 317 days between 17th March 1933 and 29th March 1934. Those taken comprised 5,548 individuals of *R. norvegicus*, 46 of *R. rattus* (of which 43 were

R. r. alexandrinus) and 801 of *S. hispidus*. Infestation rates were determined for 4,787 of *R. norvegicus* and 45 of *R. rattus* collected alive. All were examined for fleas, and for most of the time for mites and lice also, but towards the end only 10 per cent. were examined for the latter. Of the fleas, 24,528 were *X. cheopis*, 14,618 *E. gallinacea*, 10,905 *Leptopsylla segnis*, 198 *N. fasciatus*, 312 *C. felis* and 439 *Rhopalopsyllus gwyni*, and there were five others. Of the mites, only six were *Laelaps hawaiiensis*, 13,894 were *Echinolaelaps echidninus*, 313 *Eulaelaps stabularis* (Koch), 357 *Liponyssus bacoti* and 478 *A. glasgowi*, and there were 183 others. Of the Anoplura, 8,298 were *P. spinulosa*, 598 *Hoplopleura* spp. and four unidentified.

The monthly and annual numbers, means and infestation rates of all fleas and of the three chief species separately, with the adjusted indices of *X. cheopis*, are tabulated for the two species of rats and discussed. Similar data are given for mites, Anoplura, *Echinolaelaps echidninus* and *P. spinulosa* for the two host species combined. *X. cheopis* was more abundant and *Leptopsylla segnis* and *P. spinulosa* less abundant in the warm weather than the cold. *Echidnophaga gallinacea* and *Echinolaelaps echidninus* showed no significant differences. The only significant correlations between abundance and meteorological factors were those between *X. cheopis* and *L. segnis* and mean daily temperature. The correlation was positive only for *X. cheopis*. None of the species was consistently associated with the commercial part of the town. *L. segnis* and *Echidnophaga gallinacea* were significantly associated with the residential area. Outdoor rats harboured more *E. gallinacea*, but the infestation rates did not differ significantly. *X. cheopis* and *P. spinulosa* were more abundant in food-handling establishments than in residences or other business establishments, because of higher counts on infested rats. *L. segnis* and *Echinolaelaps echidninus* were significantly less prevalent in business establishments not handling food than in other types of premises. *Echidnophaga gallinacea* was most abundant in association with residences, and rats from food-handling establishments harboured significantly more of this species than did rats from the other business establishments.

The very low incidence of *Rattus rattus* and *Laelaps hawaiiensis*, probably due to the inland situation of Dothan, suggests that neither is essential to the transmission of typhus. *X. cheopis* appears the most likely local vector.

Nicholson (H. P.) & Gaines (T. B.). **A Comparison of the Effectiveness of 5 and 10 percent DDT Dusts for the Control of Rat Fleas.**—*Publ. Hlth Rep.* **63** no. 5 pp. 129–136, 4 figs., 2 refs. Washington, D.C., 1948.

In July 1946, a dust containing 5 per cent. DDT was applied for the control of ectoparasites of rats in commercial premises in Columbia, South Carolina, in the same way as the 10 per cent. DDT dust in Georgia in 1945 [*R.A.E.*, B **37** 217]. Rats were trapped before treatment, 6–8 days after treatment and at intervals of about six weeks thereafter until the onset of winter. All rats taken were *Rattus norvegicus* and as *Xenopsylla cheopis* (Roths.) was by far the most abundant flea, it was selected for a comparison of results. This showed that the control given by the 5 per cent. dust did not differ significantly over a period of three months from that given by 10 per cent. Initial control of rat mites and *Polyplax spinulosa* (Burm.) with the lower concentration was also indicated, but no conclusion was drawn as the numbers were very variable.

Sluiter (C. P.). **De dierlijke parasieten van den mensch.** [The Animal Parasites of Man.]—5th edn. revd. by N. H. Swellengrebel & J. E. W. Ihle, 9½ × 6¼ ins., viii—441 pp., 3 col. pls., 322 figs., many refs. Amsterdam, Scheltema & Holkema's Boekhandel, 1948. Price *Fl.* 16.

This concise text-book contains a section (pp. 344–429) on Arthropods that are of importance in various parts of the world as parasites of man. Apart

from Linguatulids, they comprise ticks, mites, lice, bugs, fleas and Diptera. Information is given on the morphology, distribution, life-history, feeding habits and importance of numerous individual species or groups, with mention of any pathogenic organisms that they may transmit, and keys to species or genera are included in many cases. The Diptera comprise not only species concerned in myiasis, but also those, such as mosquitos, of which the adults are well-known vectors of disease. These are dealt with more summarily.

WEYER (F.). **Bemerkungen zur gegenwärtigen Malarialage in Deutschland.** [Notes on the present Status of Malaria in Germany.]—*Ärztl. Wschr.* **3** pt. 3–4 pp. 56–59, 8 refs. Berlin, 1948.

Before the late war, the endemic district of Emden was practically the only area in Germany in which malaria persisted, but the occurrence of many introduced cases during and after hostilities [*cf. R.A.E.*, B **36** 160] among troops, repatriated prisoners of war, and refugees, and the absence of control measures and medical supervision, resulted in the production of autochthonous foci in Schleswig-Holstein, Lower Saxony, the Rhineland, north Württemberg, the district of Carlsruhe, Mecklenburg, Pomerania and Saxony, as well as in Berlin [*R.A.E.*, B **36** 160] and the eastern zone. An important focus developed in a transit camp near Hamburg. Details are given of the numbers of cases involved. Simultaneously, the mosquito population increased, especially in towns, where numerous breeding places arose in neglected canals, excavations, bombed sites and ornamental waters. Contact with man was facilitated in the primitive living and sleeping accommodation in houses, shelters and rest centres in bombed cities, and by the absence of mechanical protection. New surveys of the geographical distribution of the varieties of *Anopheles maculipennis* Mg. are, therefore, necessary. Var. *atroparvus* van Thiel was known to predominate on the coast and to be responsible for the endemic malaria in Emden, var. *typicus* was relatively rare and chiefly occurred in the mountainous regions, and var. *messeae* Flni. occurred in the interior [*cf.* **27** 78]. The last named was probably the vector of the malaria in Berlin. It is not thought likely that this distribution will have altered much.

Climatic conditions in most of Germany are not favourable for the development of malaria parasites in the mosquito vectors, and the autochthonous foci will therefore gradually disappear. Since the last epidemic in the Emden district, in 1938 [*cf.* **36** 160], a marked regression of malaria has been in progress there, and it is probable that in time it may die out in that part of Germany as well. Control measures are briefly discussed.

PAPERS NOTICED BY TITLE ONLY.

NOLAN (K.) & WILCOXON (F.). **Method of Bioassay for Traces of Parathion in Plant Material** [using larvae of *Aëdes aegypti* (L.) as Test Insects].—*Agric. Chem.* **5** no. 1 pp. 53, 74, 3 refs. Baltimore, Md., 1950. [See *R.A.E.*, A **39** 6.]

HALLER (H. L.). **Analyzing new Insecticides. A Review of Methods of Analysis and Limitations to their Use.**—*Soap & sanit. Chem.* **25** no. 6 pp. 127–129, 155, 157, 48 refs. New York, N.Y., 1949.

Consultative Committee on Insecticide Materials of Vegetable Origin. Report of the Standing Sub-committee on Methods of Analysis of Vegetable Insecticides on the world-wide collaborative Analysis of Pyrethrum Flowers 1948–1949. [Comparison of results obtained by different workers in tests of three methods of analysis.]—63 pp., multigraph. London, Colon. Prod. Adv. Bur. (Plant & Anim.), 1950. Price 4*s.*

DE ONG (E. R.). **Chemistry and Uses of Insecticides.**—$9\frac{3}{4} \times 6$ ins., viii+345 pp., 18 figs., many refs. New York, N.Y., Reinhold Publ. Corp., 1948. Price $6. [See *R.A.E.*, B **37** 96 ; A **39** 5.]

GARACI (C.). **L'andamento dell'infezione estivo-autunnale in Cassino.** [The Course of Infection with Malignant Tertian Malaria in Cassino.]—*Riv. Malariol.* **26** no. 6 pp. 283–295, 4 graphs, 14 refs. Rome, 1947. (With a Summary in English.)

Observations on malignant tertian malaria (caused by *Plasmodium falciparum*) in Cassino in 1945 and 1946 showed that the number of cases is very low in June, increases rapidly in July and still more so in August and September, and does not fall until October. This is not typical of other localities in southern and central Italy, where malignant tertian is the predominant form of malaria, as although the infections also begin to increase rapidly in July they reach a peak in early August and then diminish. The fact that *P. falciparum* seldom persists in man for more than 6–9 months indicates that the July cases are due to new infections, and since at the temperature prevailing in June, which averages about 21°C. [69·8°F.], the cycle of *P. falciparum* in the mosquito vector (*Anopheles maculipennis* var. *labranchiae* Flni.) lasts about a month, it is not clear how a sufficient number of mosquitos becomes infected from the few available gametocyte carriers to produce the rise in July.

PETA (T.). **L'infezione malarica a Gondar.** [Malaria at Gondar.]—*Riv. Malariol.* **26** no. 6 pp. 296–299. Rome, 1947. (With a Summary in English.)

A survey of the malaria situation at Gondar, Ethiopia, at an altitude of over 2,200 ft., showed that the disease is not a problem there, only introduced cases being recorded. Apart from two males that could not be identified but were certainly not *Anopheles gambiae* Giles or *A. funestus* Giles, the only Anophelines taken or reared from larvae were *A. cinereus* Theo. and *A. demeilloni* Evans, which are zoophilous. No measures against Anophelines are therefore required.

SENEVET (G.). **Nouvelles espèces d'anophèles.**—*Arch. Inst. Pasteur Algérie* **26** no. 2 pp. 149–161, 80 refs. Algiers, 1948.

A list is given of 86 species and varieties of *Anopheles* and one species of *Chagasia* from various parts of the world that have been described as new (or in one instance reinstated) between 1938 and 1947. Six of the names are thought to fall in synonymy, and others are considered of doubtful status. The validity of the eight subgenera erected since 1937 is discussed, opinions on the status of members of the *triannulatus* complex are reviewed and the composition of several other groups and complexes is given. *A. tarsimaculatus* Goeldi is considered a valid name for *A. aquasalis* Curry [*cf. R.A.E.*, B **36** 3, etc.].

PARROT (L.). **Notes sur les phlébotomes. LVIII. Phlébotomes du Soudan anglo-égyptien. 1.**—*Arch. Inst. Pasteur Algérie* **26** no. 2 pp. 121–148, 1 map, 19 figs., 25 refs. Algiers, 1948. **LIX. Phlébotomes du Soudan anglo-égyptien. 2.**—*T. c.* no. 3 pp. 259–276, 14 figs., 14 refs.

The *Phlebotomus* of the Anglo-Egyptian Sudan are reviewed on the basis of an examination of the collection of Kirk and Lewis at Khartoum. Nine species and varieties are described in the first part and 16 are described or more briefly referred to in the second. All belong to the subgenus *Sergentomyia* (*Prophlebotomus*) except *P. rodhaini* Parr., of which the female is described for the first time in the first part, and *P. alexandri* Sinton, of which the characters of a single male are noted in the second. There are three new species

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and two new varieties in the first part, including *P. affinis* var. *vorax*, the male of which had already been described as that of the typical *P. affinis* Thdr. [*R.A.E.*, B **28** 232]. One new variety is described in the second part.

SENEVET (G.). **A propos de** *Anopheles* (*Nyssorhynchus*) *ininii* **Senevet et Abonnenc, 1938.**—*Arch. Inst. Pasteur Algérie* **26** no. 3 pp. 277–279, 1 fig., 5 refs. Algiers, 1948.

The author has found that the characters of the hypopygium of a paratype male of *Anopheles ininii* Senevet & Abonnenc [*R.A.E.*, B **27** 210] are identical with those described for this species by Floch & Abonnenc [**36** 123]. He therefore confirms both that their material, which was collected in the type locality in French Guiana, was correctly identified and that the species is valid. He summarises the characters distinguishing it from related species.

SENEVET (G.). *Anopheles pessoai* **en Guyane française. Description de la nymphe.**—*Arch. Inst. Pasteur Algérie* **26** no. 3 pp. 280–287, 2 figs., 5 refs. Algiers, 1948.

Re-examination of mosquitos previously considered to be *Anopheles albitarsis* Lynch Arrib. in the author's collection from French Guiana confirmed that the species of this group in the colony is *A. pessôai* Galvão & Lane [*R.A.E.*, B **36** 191]. The distinguishing characters of the adult are given, together with a detailed description of the pupa ; divergences in various descriptions of the male hypopygium and larva are also noted.

LEVÍ CASTILLO (R.). **Atlas de los anofelinos sudamericanos.** [Atlas of South American Anophelines.]—207 pp., 52 pls., 1 map, 44 pp. refs. Guayaquil, 1949.

In the preliminary sections of this book, the author divides South America (including the Isthmus of Panama) into seven regions of endemism similar to but not identical with those defined by Lane [*R.A.E.*, B **34** 33], shows their boundaries on a map and gives lists of the species of Anophelines (*Anopheles* and *Chagasia*) that occur in each, with indications of which are endemic and the predominant groups, and of all the species, showing in which countries they occur and their breeding places and adult habits. These are followed by a list of the 15 South American species of *Anopheles* that are or may be vectors of malaria, showing their distribution, and a summary of methods of obtaining various statistical indices useful in control operations, based on earlier work by A. Gabaldón. The book concludes with a systematic section containing descriptions of all stages for the genera *Anopheles* and *Chagasia* and of all or some of them for the various groups within the genus *Anopheles*, and keys to the subgenera and species based on eggs, larvae, adult females and male terminalia. The numerous figures include illustrations of characters of eggs, larvae and adults of the various species that are important for identification.

HEISCH (R. B.). **Two Years medical Work in the Northern Frontier District, Kenya Colony.**—*E. Afr. med. J.* **24** no. 1 pp. 3–15, 1 map, 1 graph, 4 refs. Nairobi, 1947.

The greater part of this report deals with malaria, which is widespread in the Northern Frontier District of Kenya, with frequent epidemics after the rains. The vector is *Anopheles gambiae* Giles, which breeds in rivers, pools in river beds, water leaking from wells and occasionally rain water. It is sometimes extremely abundant after the rains. *A. funestus* Giles is present only in

small numbers. The incidence of the disease and the Anopheline and other mosquitos recorded in various parts of the district are reviewed. Data are given on the monthly rainfall and catches of females of *A. gambiae* in 1941–45 in Isiolo, one of the chief endemic areas, and also lists of eight species of *Anopheles* in addition to *A. gambiae* and 19 species of *Aëdes* and *Culex* recorded there.

Visceral leishmaniasis (kala-azar) has only occasionally been recorded in Kenya [*cf. R.A.E.*, B **32** 87]. In 1942–44, the author saw two proved cases in the Northern Frontier District and several unconfirmed ones. A collection of local sandflies (*Phlebotomus*) made in a tent in March 1943 and identified by D. J. Lewis comprised, in addition to an undescribed species, *P. squamipleuris* Newst., which was much the most abundant, and *P. langeroni* var. *orientalis* Parrot and *P. clydei* Sinton, both of which are known to bite man [*cf.* **28** 201–202 ; **38** 218].

Relapsing fever is mainly confined to Moyale, and a small epidemic occurred there in 1943. The number of cases and the amount of rainfall in each month of 1943 and 1944 are given. There was an apparent correlation in 1943, but less in 1944. The vector is not known. Ticks of the genus *Ornithodoros* were not found at Moyale, but *O. savignyi* (Audouin) occurred in large numbers under trees in two other localities.

GRAINGER (W. E.). **The experimental Control of Mosquito Breeding in Rice Fields in Nyanza Province, Kenya, by intermittent Irrigation and other Methods.**—*E. Afr. med. J.* **24** no. 1 pp. 16–22, 2 refs. Nairobi, 1947.

In 1942, schemes were begun for the production of rice in Kenya on a large scale. In one area near Kisumu, intermittent irrigation was tested in two seasons as a means of preventing extensive Anopheline breeding in the rice-fields but failed to give adequate control because the nature of the soil made drying-off very slow. In the second season, one plot was treated by allowing oil to drip from a can into the irrigation canal feeding it, and another by the introduction of *Gambusia*. The oil was applied every three or four days, when the water in the plot needed replenishment, and was very effective when the rate of dripping was adjusted to the amount of water flow ; it was found advantageous to make an opening on the far side of the plot and continue application until a film of oil was seen on the water escaping from this opening. *Gambusia* had little or no effect on mosquito production, possibly because the vegetation was thick, though its numbers increased from 97 to over 1,200 in four months.

Anopheles gambiae Giles and *A. pharoensis* Theo. bred persistently in the rice-fields throughout the two seasons of observations, and *A. funestus* Giles and *A. coustani* Lav. appeared during the third month in each season. The last two species were affected by intermittent irrigation. The average numbers of mosquitos of each of 14 species taken per 144 sq. ft. in 24 hours in cages over plots of rice during June, July and August 1943 are shown in a table. From this, it is calculated that the production of *A. gambiae* per acre per day in June was about 1,000. A list is given of the 30 species of mosquitos recorded during the investigation.

HARPER (J. O.). **A Mosquito Survey of Mahé, Seychelles.**—*E. Afr. med. J.* **24** no. 1 pp. 25–29, 3 refs. Nairobi, 1947.

VAN SOMEREN (E. C. C.). **Appendix. The Description of a new Mosquito from the Seychelles.**—*T.c.* pp. 29–35, 4 figs., 1 ref.

Lists are given of seven species of mosquitos recorded by Edwards from the Seychelles in a work already noticed [*R.A.E.*, B **29** 114] and of eight found in a survey made in 1945 in and near Victoria, Mahé, with brief notes on the breeding

places of the latter. The two lists together comprise 13 species, which belong to the genera *Culex*, *Aëdes* and *Uranotaenia*, and the second includes the new species of *Culex* described in the appendix. *Anopheles gambiae* Giles was introduced to one of the outer islands of the group in 1930 [**20** 61] but has since been eradicated. Recommendations are made for mosquito control, including measures for dealing with potential Anopheline breeding places. Before the survey, the only measures taken were the spraying of ships and aircraft on arrival from Africa and anchoring ships half a mile from the pier until pratique had been granted. This was to guard against the introduction of yellow fever and was shown to be necessary by the finding in 1945 of a female of *Aëdes aegypti* (L.) on a ship that had left Mombasa 12 days previously and called at no intermediate port. In a survey of 218 premises, mosquito larvae were found in 17·8 per cent. and larvae of *A. aegypti* in 5·5 per cent. Adult mosquitos were fairly numerous in dwellings. *A. albopictus* (Skuse) was widespread and attacked readily in the daytime.

Furlong (M.). *Aedes* **Control at Lamu.**—*E. Afr. med. J.* **24** no. 1 pp. 36–38. Nairobi, 1947.

A description is given of the organisation of weekly house inspections and the methods used to control mosquito larvae, largely *Aëdes aegypti* (L.), in and near dwellings at Lamu, a port on the island of the same name, off the Kenya coast. Breeding in cement water tanks in dark parts of houses was reduced to negligible proportions by stocking with larvivorous fish, which were also effective in wells. The numbers of houses inspected and the percentages in which larvae of any species and larvae of *A. aegypti* were found (general and *aegypti* indices) are given for March 1941 before control began and for December in that and the next four years after control was in force. Results were excellent. The general index fell from 40·2 to 0·16 in December 1945 and the *aegypti* index from 23·2 to 0·16. Thereafter, inspections were made only fortnightly. Boats in the harbour were inspected regularly and breeding in them controlled while they remained in port. *A. aegypti* was found in seven craft out of more than 2,000.

Bailey (K. P.). **A preliminary Note on the sylvan Mosquitos of Gede.**—*E. Afr. med. J.* **24** no. 1 pp. 38–41, 1 pl., 1 graph, 4 refs. Nairobi, 1947.

Records are given of sylvan mosquitos taken at Gede, about 65 miles north of Mombasa on the Kenya coast, in a survey with special reference to yellow fever begun in 1941, together with notes on the breeding places and adult habits when known of 13 of them. Immunity from the disease was found in 9 out of 46 local bush babies (*Galago crassicaudatus lasiotis*). The only mosquitos that showed marked tendencies to haunt the upper strata of the forest canopy [*cf. R.A.E.*, B **32** 184 ; **37** 208, etc.] were *Aëdes adersi* (Edw.), *A. taylori* Edw. and *A. furcifer* (Edw.). *A. taylori* has transmitted yellow fever in the laboratory [**31** 21], and it is probable that one or more of the three species named are jungle vectors at Gede.

van Someren (E. C. C.). **The Description of a new** *Anopheles* **of the** *Myzorhynchus* **Series from Madagascar with Notes on its systematic Position in Relation to the Ethiopian Species of this Group.**—*E. Afr. med. J.* **24** no. 1 pp. 42–46, 2 figs., 1 ref. Nairobi, 1947.

Descriptions are given of the adults of both sexes, pupa and larva of *Anopheles fuscicolor*, sp. n., from Madagascar, together with notes on its relation to the other species of the *Myzorhynchus* series occurring in the Ethiopian region. The larvae were found with those of *A. coustani* Lav. in rice-fields at Fianarantsoa, and the adults were taken in native huts.

McMahon (J. P.). **Simuliidae of Kenya.**—*E. Afr. med. J.* **24** no. 1 pp. 51–56, 7 refs. Nairobi, 1947.

In view of the discovery in 1938 that onchocercosis [caused by *Onchocerca volvulus*] was widespread in parts of Kenya [*cf. R.A.E.*, B **35** 109], notes are given on the bionomics of Simuliids, including *Simulium neavei* Roub. and *S. damnosum* Theo., which are the vectors. These are the only two of some 30 species found in Kenya of which the adult habits are known to any extent. *S. neavei* is confined to western Kenya, and *S. damnosum* occurs in such small numbers that it is doubtful whether it is of much importance in transmission in the colony. *S. neavei* is found near waterfalls in fairly heavy bush and seems to prefer to feed between 9 and 11.30 a.m. and 3 and 6.30 p.m. Its activity is most obvious on dull days. The adults do not enter houses.

Harvey (A. E. C.). **The Care and Maintenance of Laboratory Animals and Arthropod Vectors of Diseases.**—*E. Afr. med. J.* **24** no. 1 pp. 58–71, 9 refs. Nairobi, 1947.

Descriptions are given of methods of rearing or maintaining laboratory animals and of rearing ticks of the genus *Ornithodoros*, bugs (*Cimex* spp.), *Pediculus humanus humanus* L. (*P. h. corporis* Deg.), rat fleas, *Musca domestica* L., sandflies (*Phlebotomus*) and mosquitos.

Davidson (G.). **Field Trials with "Gammexane" as a Means of Malaria Control by Adult Mosquito Destruction in Sierra Leone. I. The Effect of "Gammexane" on Mosquitoes.**—*Ann. trop. Med. Parasit.* **41** no. 2 pp. 178–209, 3 pls., 2 figs., 2 maps, 8 refs. Liverpool, 1947. **II. The Effect of Treatments of Houses with "Gammexane" on the Malaria-rate in the Inhabitants.**—*T. c.* pp. 210–214, 1 ref.

The following is largely based on the author's summary of the first paper and conclusions to the second. Three areas in Sierra Leone were chosen in 1946 for trials of BHC (benzene hexachloride) for the control of adults of *Anopheles gambiae* Giles, *A. melas* Theo. and *A. funestus* Giles in houses. Parts of the areas were left untreated as controls, and mosquito-catches in treated and untreated parts were compared. Trials with smoke-generators (2-oz. pellets containing 25 per cent. BHC of which 13 per cent. is γ isomer) used at the rate of one pellet per room (1·8 gm. γ BHC per 500–2,000 cu. ft. of which half may be destroyed in burning) did not show much promise owing to inadequate retention of the smoke by the houses. These were kept closed as far as possible for an hour. Some control was effected for 1–3 weeks after treatment. Trials of BHC sprays to leave a toxic residue gave much more promising results, and very considerable reductions in mosquito densities in treated houses were maintained over periods varying from one to six months, the duration of effectiveness depending on the rate and thoroughness of application of the insecticide and the proportion of the area treated. Kerosene solutions of γ BHC (95 per cent. pure) were used for most of the work, but kerosene solutions or wettable-powder suspensions of crude BHC (13 per cent. γ isomer) and an emulsified solution were also tested. The sprays were applied at concentrations ranging from about 0·1 to 1 per cent. γ isomer, and rates varying from 1 to about 20 mg. γ isomer per sq. ft. of wall surface. It is concluded that a solution or mixture containing 0·5 per cent. γ isomer applied at 10 mg. γ isomer per sq. ft. (4 pints liquid per 1,000 sq. ft.) to all the internal wall surfaces of all the houses in an area will reduce the mosquito density in these houses to almost nil over a period of about six months. Evidence is produced to show that treatment of houses in part of an area reduces the mosquito population not only in the part treated, but also in adjacent parts up to a distance of 1–2 miles.

In examinations of children made in two of the areas for 12–22 weeks after the application of spray, little or no difference in the rate or intensity of infections with malaria parasites was detected. However, infections acquired just before the beginning of the trials would probably not have had time to die out, and it is considered that examinations over a period of at least a year would be necessary before reliable conclusions could be drawn.

MATTINGLY (P. F.). **Notes on the early Stages of certain Ethiopian Mosquitoes, with some Locality Records from British West Africa.**—*Ann. trop. Med. Parasit.* **41** no. 2 pp. 239–252, 4 figs., 20 refs. Liverpool, 1947.

Records, nearly all from the author's personal observations between September 1942 and December 1944, are given of mosquitos occurring in various localities in Nigeria, the Gold Coast and Sierra Leone. New records are indicated. Descriptive notes are also given on the larvae and pupae of *Anopheles domicolus* Edw. and *A. turkhudi* Liston, the pupae of *A. wilsoni* Evans, *A. nili* Theo., *A. hargreavesi* Evans, *A. argenteolobatus* Gough and *A. multicolor* Camb., and the larva of *Aëdes grahami* Theo. The unassociated larvae attributed to *Anopheles domicolus* by Evans in a work already noticed [*R.A.E.*, B **26** 182] are now known to have belonged to some other species, whereas the larva described by Mattingly in a paper already noticed [**33** 160] as possibly that of *A. theileri* var. *brohieri* Edw. has been shown to be *A. domicolus*. Edwards suggested in a footnote in Evans' monograph [**26** 182] that *A. hispaniola* Theo. was a synonym of *A. turkhudi* and was followed by Russell, Rozeboom & Stone [**32** 102]. However, there are well-marked differences between the larvae and pupae of the two species, so that they should be considered distinct. These differences are described.

BERTRAM (D. S.). **The Period required by *Litomosoides carinii* to reach the infective Stage in *Liponyssus bacoti*, and the Duration of the Mites' Infectivity.**—*Ann. trop. Med. Parasit.* **41** no. 2 pp. 253–261, 9 refs. Liverpool, 1947.

Observations by various workers in which the date of the mites' first infecting meal was not accurately known indicated that the period required for larvae of *Litomosoides carinii* to become infective in *Liponyssus bacoti* (Hirst) was from two to three weeks. Bertram, Unsworth & Gordon, in work in which the time of infection was known within 24 hours, found active worm-like forms, some probably infective, in the mites after 20–33 days [*R.A.E.*, B **37** 140], and it was later seen that the mites had transmitted the infection to a white rat and that transmission was associated with their feeding activity. However, the time required for them to become infective and the duration of infectivity were still not known. Experiments were accordingly undertaken to investigate these points. The methods used are described.

The following is based on the author's summary of the results. Adult female mites infected by feeding during one 24-hour period on an infected cotton rat [*Sigmodon hispidus*] and then stored at 23–25°C. [73·4–77°F.] and maintained by blood-meals on white rats and cotton rats at intervals of about five days for 35 days first transmitted *Litomosoides carinii* to either host on the occasion of the third meal, on the 15th day. They transmitted infection again to cotton rats at the fourth and fifth meals, on the 20th and 25th days. Of two cotton rats each exposed for 24 hours to 30 mites of a series in which 38 per cent. were infected, one exposed on the 15th day after the mites' infecting meal developed an infection averaging 275 mf./cu. mm. peripheral blood (range 90–670 mf./cu. mm.) in 20 weekly counts, and the other exposed on the 20th day developed an infection averaging 97 mf./cu. mm. peripheral

blood (range 40–190 mf./cu. mm.) over 18 weekly counts. The numbers of engorged mites recovered from the hosts were 17 and 19, respectively. A third cotton rat exposed to 13 mites of the same series on the 25th day of their infection, three of which were recovered engorged, contained only one male of *L. carinii* when dissected following its death 44 days after exposure. Cotton rats were first found to have demonstrable microfilariae of *L. carinii* in the peripheral blood 51–54 days after exposure to infected mites [*cf.* **38** 191].

Non-infective inactive forms of the worm with sickle-shaped tails occurred in the mites on the ninth and tenth days after the infecting feed and active thread-like ones 0·5–1 mm. long from the 14th to the 36th day. It is concluded that these are the infective forms. When dissected before their first infective (third post-infecting) meal, 38 per cent. of 29 mites that had engorged on a cotton rat showing 2,584 mf. cu. mm. peripheral blood were positive for developmental forms of the worms with 1–5 each and 21·8 per cent. of 37 mites that had engorged on the same rat on a different occasion when the blood count was 3,000 mf./cu. mm. were positive with 1–2 worms each. It is concluded that although transmission appears to be associated with feeding, the possibility of its being effected in other ways cannot be discounted.

Unsworth (K.), Edwards (H.) & Bertram (D. S.). **Failure to control *Hypoderma* by the Spraying of Oviposition Sites on Cattle with "Gammexane".**—*Ann. trop. Med. Parasit.* **41** no. 2 pp. 262–265, 5 refs. Liverpool, 1947.

An account is given of an attempt made on a farm in Britain to control warble flies (*Hypoderma*) by spraying the oviposition sites on cattle repeatedly with BHC (benzene hexachloride) to kill either the adult fly, the egg or the newly hatched larva. One application of DDT had been tried for this purpose by Matthysse without success [*R.A.E.*, B **34** 173]. Heifers treated weekly from early May to late September 1946 with a spray containing 0·1 per cent. γ BHC as an emulsified solution applied to the legs, belly, brisket, escutcheon and the base of the tail to give a deposit of 3 gm. γ BHC per animal (about 100 mg. per sq. ft.) had as many warbles in 1947 as untreated controls. By exposing house-flies (*Musca domestica* L.) to hair from treated and control animals, it was shown that γ BHC in the amount used did not persist on the hair of a living animal kept under field conditions, no trace of it being left after a week. Hair taken from cattle an hour after spraying and kept in the open in a wire container for a week gave complete kill of house-flies in three hours. Subsidiary experiments showed that more than 12 gm. γ BHC per animal (a quantity that is not economically practicable) would be needed to ensure persistence of an effective concentration for a week.

Elliott (M.), Needham (P. H.) & Potter (C.). **The insecticidal Activity of Substances related to the Pyrethrins. I. The Toxicities of two synthetic Pyrethrin-like Esters relative to that of the natural Pyrethrins and the Significance of the Results in the Bioassay of closely related Compounds.**—*Ann. appl. Biol.* **37** no. 3 pp. 490–507, 13 figs., 19 refs. London, 1950.

An account is given of experiments noticed in somewhat more detail elsewhere [*R.A.E.*, A **39** 50] in which the toxicity as contact insecticides of the esters of *dl*-3-methyl-2-allyl-cyclopent-2-en-4-ol-1-one with the natural *d-trans*- and the synthetic *dl-cis-trans*-chrysanthemum monocarboxylic acid [of which the second ester is known as allethrin (B **38** 208; *cf.* also B **38** 103)] was compared with that of the natural pyrethrins in sprays against five species of test insects, mainly pests of crops. Both esters showed high insecticidal activity, but the relative toxicity of the partly synthetic esters to different

species ranged from one-eighth to nearly four times that of the pyrethrum standard, and from about twice to considerably less than twice that of the completely synthetic one. It is well known that chemicals of widely different structure and mechanism of action may differ greatly in relative toxicity to different insects, but the fact that these differences may also occur with related chemicals with, presumably, a similar mechanism of action, has not been clearly stated.

BLACKITH (R. E.). **Bioassay Systems for the Pyrethrins. III. Application of the Twin Cross-over Design to crawling Insect Assays.**—*Ann. appl. Biol.* **37** no. 3 pp. 508–515, 12 refs. London, 1950.

In this part of a series on methods for the bioassay of pyrethrins [*R.A.E.*, B **38** 34, 36], the author describes the twin cross-over experimental design, which has not apparently been so far used for insecticidal assay, and demonstrates its suitability for use with crawling insects ; it is also of value for flying insects confined to surfaces. The method consists in exposing groups of test organisms to solutions of the standard and test toxicants, each at a high and a low concentration and, after a period for recovery, repeating the experiment but reversing the toxicant solutions, so that the pair of groups that were originally exposed to the test solutions are now exposed to the standard ones and the pair that received the high concentrations receive the low ones. The method cannot be used with materials that cause death or irreversible paralysis, but appeared suitable for use with the pyrethrins, paralysis by which was shown by tests on a weevil to be completely reversible. The use of the method is illustrated by an example, and its advantages and the analysis of the results are discussed.

STODDARD (R. B.) & DOVE (W. E.). **Cinerin I Homolog tested. A preliminary Evaluation of the insecticidal Effectiveness of the completely synthetic allyl Homolog of Cinerin I.**—*Soap & sanit. Chem.* **25** no. 10 pp. 118–121, 161, 2 graphs, 5 refs. New York, N.Y., 1949.

In experiments with the completely synthetic allyl homologue of cinerin I [the ester now known as allethrin (*cf. R.A.E.*, B **38** 208 ; **39** 23)], sprays were prepared by dissolving the compound in odourless kerosene at selected concentrations and dusts by impregnating selected concentrations on an organic base and diluting with pyrophyllite. Pyrethrum standards of comparison were prepared from an extract of pyrethrum flowers of known pyrethrin content. In tests on adult house-flies [*Musca domestica* L.] by a modification of the turntable method [*cf.* **26** 246] and by the small-group Peet-Grady method [*cf.* **37** 5, 89], the slopes of the dosage-mortality curves were steeper for allethrin than for pyrethrins, and the lines for the two materials crossed, indicating that allethrin is less toxic than natural pyrethrins at low concentrations and more toxic at higher ones. They were equally effective at concentrations of about 150 mg. per 100 ml. in tests by the Peet-Grady method and at 100 mg. per 100 ml. by the turntable method. Allethrin is apparently considerably more effective than pyrethrins at relatively high concentrations by the turntable method, but this apparent margin of superiority practically disappears when the two materials are tested by the other method.

Allethrin at concentrations of 100 and 200 mg. per 100 ml. was inferior to pyrethrins at half these concentrations in both initial knockdown and mortality in tests against adult males of the German cockroach [*Blattella germanica* (L.)] by a direct spray method [*cf.* **38** 208]. It was also inferior in tests of surface deposits against adults of the confused flour beetle [*Tribolium confusum* Duv.] and of dusts against nine species of insects that are pests of crops [*cf.* A **39** 53].

GERSDORFF (W. A.). **Toxicity to Houseflies of new synthetic Pyrethroid.**—*Soap & sanit. Chem.* **25** no. 11 pp. 129, 131, 139, 4 refs. New York, N.Y., 1949.

Tests were made by the turntable method [*cf. R.A.E.*, B **26** 246] of the toxicity to house-flies (*Musca domestica* L.) of the completely synthetic allyl homologue of cinerin I [now known as allethrin] and the isomeric form of this compound in which the natural *d-trans*-chrysanthemum monocarboxylic acid was used for esterification [*cf.* **38** 103, 208 ; **39** 23]. The standard pyrethrum extract [**38** 103] was used for comparison. The completely synthetic material and a year-old sample of the other were used both before and after distillation in a high vacuum to eliminate undesirable colour and odour, and a recently prepared sample of the latter was used after distillation. The completely synthetic material gave 29, 64 and 79 per cent. mortality at concentrations of 0·5, 1 and 2 mg. per ml. and was found to be about three times as toxic as the standard, the concentrations required for 50 per cent. mortality being 0·85 and 2·76 mg. per ml., respectively. Moreover, the toxicity ratios did not differ significantly at the concentrations required for 30 or 80 per cent. mortality [*cf.* preceding abstract]. The isomer synthesised with the natural acid and stored for a year at 8°C. [46·4°F.] was six times as toxic as the standard, being thus about as toxic as it was when freshly prepared [**38** 103]. Distillation had no measurable effect on the toxicity of either of the isomers.

FAN (H. Y.), CHENG (T. H.) & RICHARDS (A. G.). **The Temperature Coefficients of DDT Action in Insects.**—*Physiol. Zoöl.* **21** no. 1 pp. 48–59, 10 graphs, 16 refs. Chicago, Ill., 1948.

In view of several reported instances in which mortality of insects treated with DDT has been greater at low than at high temperatures [*R.A.E.*, A **36** 380 ; B **34** 134 ; **35** 194 ; **36** 127], the relation between toxicity of DDT and temperature was investigated in the laboratory. The tests were carried out chiefly on larvae of *Chaoborus* sp. and *Aëdes aegypti* (L.), but larvae of *Tipula abdominalis* (Say) and adults of a crayfish, *Cambarus* sp., were also used. When immersed in colloidal suspensions of DDT at concentrations of 1 in 10, 100, 500 or 1,000 million, mortality among larvae of *Aëdes* and *Chaoborus*, both of which were highly susceptible, increased with rising temperatures at the two higher concentrations, but decreased at the lower ones. A similar relation appeared to exist for larvae of *Tipula*, which were, however, considerably more resistant to DDT, and the crayfish was too resistant to give conclusive results. Pre-treatment in dilute concentrations of DDT at low temperatures increased mortality among larvae of *Aëdes* and *Chaoborus* in subsequent tests at higher temperatures ; pre-treatment at high temperatures had little effect on the mortality of *Aëdes* in subsequent tests at lower ones, but results obtained with *Chaoborus* were inconclusive. When DDT at suitable concentrations in emulsified solution was injected into *Cambarus* sp. and larvae of *Aëdes* and *Tipula*, there was no increased mortality at low temperatures. It thus appears that the negative temperature response with dilute suspensions was due to some property of the body-wall. It is concluded from a discussion that the cuticle is probably responsible and that its action is possibly that of concentrating DDT by absorption processes, since earlier investigations have indicated that DDT can be removed from suspension by Arthropod cuticle but not by living tissue.

WEYER (F.). **Vergleichende Untersuchungen an Rickettsien.** [Comparative Investigations on Rickettsiae.]—*Z. Naturforsch.* **2**b pt. 9–10 pp. 349–358, 13 refs. Wiesbaden, 1947.

The investigations described were carried out during four years in Germany with *Rickettsia prowazekii* and *R. p. mooseri* (typhus rickettsiae), the former

represented by five freshly isolated strains obtained from typhus patients in eastern Europe and the latter being a Mexican strain preserved in mice, and *R. quintana* (*wolhynica*) (trench fever), of which several strains were obtained by feeding lice on patients.

R. quintana is distinguished from other pathogenic rickettsiae by its lack of virulence for the usual laboratory animals, and the author confirmed this behaviour. *R. prowazekii* is commonly held to be distinguished from *R. p. mooseri* by the reactions of laboratory animals, but the close relations of these two rickettsiae can sometimes entirely obscure these differences, and Mooser has reported the production of one rickettsia from the other by suitable passages [*cf. R.A.E.*, B **20** 245]. In the author's experiments, *R. prowazekii* produced no constant reactions in laboratory animals and was not distinguishable from *R. p. mooseri* on that basis. Neither caused periorchitic changes in guineapigs.

In the stomachs of clothes lice [*Pediculus humanus humanus* L.], *R. quintana* develops extracellularly and has no effect on the insect host, while *R. prowazekii* and *R. p. mooseri* enter the epithelial cells, develop intracellularly and frequently cause the death of the lice. These two sorts of behaviour are accompanied by morphological differences. The lice appear to show a resistance to *R. prowazekii*, usually only about 30 per cent. becoming infected when fed on human patients as compared with 100 per cent. by rectal injection, and the infection is sometimes overcome. Changes in virulence also occur. The most important observation was, however, that both *R. prowazekii* and *R. p. mooseri* sometimes leave the epithelial cells and develop extracellularly in the louse stomach. All the rickettsiae present or only some of them may be involved in the change, and it is usually not complete until after the following passage. In about half the experiments, the rickettsiae again became intracellular after further passages. When they become extracellular, the rickettsiae become harmless to lice, mice and guineapigs and indistinguishable in all known properties from *R. quintana*. The change from the intracellular to the extracellular position in these rickettsiae occurred not only as a spontaneous phenomenon in the course of the normal louse passages by feeding or rectal injection, but also following injection into the body cavity through the genital aperture, following explanting of infected louse stomach by the hanging drop method (especially in the absence of mammalian tissue), and following injection of dried louse stomach infected with *R. p. mooseri* or powdered louse excreta containing *R. prowazekii*. The injections through the genital aperture demonstrated the great affinity of all three rickettsiae for the louse stomach, but infection of the ovaries and eggs sometimes occurred. Infection of the eggs was irregular and not common. In a single test, infected lice hatched from infected eggs and took a blood-meal, but died in a few days without moulting. The rickettsiae were intracellular.

R. prowazekii and *R. p. mooseri* were also transmitted to *Leptopsylla segnis* (Schönh.) by feeding on infected mice and by rectal injection, and to head lice [*P. h. capitis* Deg.] by rectal injection, and change from the intracellular to the extracellular position occurred in the fleas. These two rickettsiae were also transmitted to *Rhipicephalus bursa* C. & F. and *Argas reflexus* (F.) and all three to *Ornithodoros moubata* (Murr.) by injection through the rectum or genital aperture. Intracellular rickettsiae became extracellular in some of the tests with *Argas* and *Ornithodoros*, and a further change in the reverse direction occurred in *Ornithodoros*. Eggs infected with virulent rickettsiae were obtained from *Rhipicephalus*, and F_1 nymphs infected with *R. prowazekii* and eggs and coxal fluid infected with *R. p. mooseri* from *Ornithodoros*. In further experiments with various insects, the rickettsiae were transmitted to larvae of *Tenebrio molitor* L., in which they often lost their intracellular position.

The significance of the change in position of the intracellular rickettsiae and the alterations of virulence is discussed at some length. Loss of virulence to mice is apparently accompanied by a loss of immunising ability. The extracellular forms are more difficult to maintain in a non-specific environment such as a hen's egg or tick, and persist best in lice. The change in position occurred most often following a change of host or environment, and in three of the cases in which it occurred spontaneously, the lice were subsequently shown to have been injured by bacteria, chemicals or heat. No certain method of inducing it is known. Neither is it known whether it is due to injury of the rickettsiae, the intervention of a special stage of depression or rest in which certain properties of the rickettsiae become suppressed, or the effect of external or endogenous processes. It cannot be shown whether it is due to modifications or mutations in strains, since pure clones of rickettsiae are unobtainable. Its result is, however, to make it impossible to distinguish the rickettsiae of lice and man in the usual ways. These may represent a single organism with variable characters or a mixture of species or types in which different forms become dominant at different times. The complex probably also includes the extracellular rickettsia described by Herzig [**28** 109], the forms known as *R. weigli* [**25** 76] and *R. pediculi* [**28** 110], and possibly also *R. rocha-limae*, which occurs both intra- and extracellularly in lice. Distinction by any criterion is particularly difficult in the case of *R. prowazekii* and *R. p. mooseri*, since the differences between strains of the former are often greater than those between it and the latter.

WEYER (F.). **Über *Rickettsia wolhynica* und die Diagnose des Wolhynischen Fiebers durch den Läuseversuch.** [On *R. quintana* and the Diagnosis of Trench Fever by the Louse Test.]—*Zbl. Bakt.* (I. Orig.) **152** pt. 6 pp. 403–414, 15 refs. Jena, 1948. (With Summaries in Russian, English and French.)

Trench (Wolhynian) fever, which is caused by *Rickettsia quintana* (*wolhynica*), has proved difficult to diagnose, and the only two certain methods are Weigl's agglutination test, for which a pure culture of the rickettsia, such as can only be obtained from the stomachs of infected lice [*Pediculus humanus humanus* L.], is required, and xenodiagnosis, in which healthy lice are fed on the patient and subsequently examined for the rickettsia. The author reviews information on the behaviour of *R. quintana* in man and laboratory animals, largely from the literature, and in lice, mainly from his own work with a strain isolated from a patient in 1944 and maintained through 50 louse passages in the laboratory. Passages were effected by rectal injection of infected louse stomach in saline, and did not need to be made at short intervals since infected lice live as long as normal ones (30–40 days for females).

The presence of the rickettsiae in the lice can be demonstrated by section or, more easily, by a smear of the stomach epithelium, prepared in the same way as a blood-smear. *R. quintana* is larger and more compact in form than *R. prowazekii* or *R. p. mooseri*, and stains more evenly. It never occurs in balls or agglomerations and is further distinguished by its extra-cellular position in the lice [but *cf.* preceding abstract]. Its development in the louse stomach reaches its peak after 7–8 days, when the lumen is usually filled with rickettsiae. Elimination in the excreta and the appearance of degenerate forms in the stomach then begin. Data on the transmission of *R. quintana* to other experimental insects and ticks are given from work already noticed [see preceding abstract]; it was transmitted to head lice [*P. h. capitis* Deg.] and developed in them, so that these lice may play a greater part in transmission than has been thought. Observations on explantation and yolk-sac culture are recorded. The rickettsiae survived for 2½ years in dried louse excreta and for 219 days in

dried louse stomachs, but rickettsiae preserved in these ways sometimes lost their power of multiplying in lice.

The results of xenodiagnosis in numerous hospital cases in Hamburg are discussed. Batches of 30–80 lice are used, since some die and many do not become infected. They are fed for an hour in the morning and an hour in the afternoon on the lower leg or arm of the patient and kept at 30–32°C. [86–89·6°F.] between feeds. They are transferred to a fresh cage after five days, to avoid the hatching of eggs, and a gross test for infection is made on the following day. Unless this is definitely negative, detailed examination of some or all of the lice is made on the seventh or eighth day. The process enabled diagnosis to be made in many doubtful cases.

SCHLOTE (A.). **Abtötung von Fleckfieber-Rickettsien durch einige Wasch- und Desinfektionsmittel.** [The Killing of Typhus Rickettsiae by certain Cleaning and Disinfecting Agents.]—*Zbl. Bakt.* (I. Orig.) **152** pt. 6 pp. 414–419, 1 ref. Jena, 1948. (With Summaries in Russian, English and French.)

An account is given of experiments showing that typhus rickettsiae (*Rickettsia prowazekii*) in the excreta of infected lice [*Pediculus humanus humanus* L.] were killed by treatment for seven minutes with carbon bisulphide, ether, cresol, tetramine, ethylene chloride or 25 per cent. ammonia, but not by treatment for one hour with carbon tetrachloride or benzene. They were also killed by dry exposure for one hour to a temperature of 39 or 41°C. [102·2 or 105·8°F.]. The presence or absence of rickettsiae in the excreta was shown by rectal injection into healthy lice, and in the course of this work, one of the two strains of lice used was found to be resistant to infection.

WEYER (F.). **Die künstliche Infektion von Zecken mit Rickettsien und anderen Krankheitserregern.** [The artificial Infection of Ticks with Rickettsiae and other Agents of Disease.]—*Zbl. Bakt.* (I. Orig.) **152** pt. 7 pp. 449–457, 9 refs. Jena, 1948. (With Summaries in Russian, English and French.)

The author gives a more detailed account than one in a paper already noticed [*R.A.E.*, B **39** 26] of experiments in which *Rickettsia prowazekii*, *R. p. mooseri* and *R. quintana* (*wolhynica*) were transmitted by injection to ticks and developed in them. He also summarises the results of experiments with ticks and the agent thought to be *R. burneti* and the viruses of mouse bronchopneumonia and human influenza [**38** 199–200].

CABLE (R. M.). **An illustrated Laboratory Manual of Parasitology.**—Revd. edn., [1+]viii+152 pp., 121 figs., 3¼ pp. refs., multigraph. Minneapolis, Minn., Burgess Publ. Co., 1950. Price $2.25.

This manual, of which the first edition appeared in 1940, consists of a detailed plan for an introductory laboratory course for college students in the recognition of the principal protozoa, helminths and arthropods that parasitise or attack man, supplemented by comparative study of species from other hosts. There is a section on laboratory techniques.

Entomological Investigations.—*21st Rep. Coun. sci. industr. Res. Aust. 1946–47* pp. 19–25. Canberra [? 1948]. **Animal Health and Production Investigations.**—*T.c.* pp. 25–33. **Entomological Investigations.**—*22nd Rep. Coun. sci. industr. Res. Aust. 1947–48* pp. 20–26. Canberra [? 1949]. **Animal Health and Production Investigations.**—*T.c.* pp. 26–33. **Sheep.**—*1st Rep. Commonw. sci. industr. Res. Org. Aust. 1948–49* pp. 37–46. Canberra [? 1950]. **Cattle.**—*T.c.* pp. 46–49. **Entomology.**—*T.c.* pp. 49–55.

All three reports include accounts of further experiments in Australia [*cf. R.A.E.*, B **36** 103 ; 118] on the control of the cattle tick [*Boophilus annulatus*

microplus (Can.)]. In 1946–47, widespread dipping experiments in Queensland showed that 0·5 per cent. DDT as Rucide [**36** 101] was effective against arsenic-resistant strains of the tick. The deposit was toxic for 1–3 weeks after treatment, and no irritation was caused. Well fed, moderately infested cattle were freed from infestation by dipping twice in suspensions of not less than 0·35 per cent. DDT, but impoverished, heavily infested stock would require some preliminary treatment. In the following year, dips containing 0·5 per cent. p,p′DDT from a powder or dispersible paste were less toxic than some DDT dips previously used. A paste of BHC (benzene hexachloride) was also tested ; it gave good control and protection for eight days at 0·25 per cent. γ isomer, but with continual use and normal replenishment of the dip, the toxicity and period of protection both declined. Between treatments, the surface concentrations of both DDT and BHC fell as a result of the rapid settling of the particles. Such dips can be readily stirred by passing cattle through them, but these animals must be redipped in the stirred suspension.

In laboratory investigations in the same year, engorged female ticks were dipped in 1 per cent. alcoholic solutions of various toxicants and observed for oviposition. Toxaphene and chlordan were the best of the 13 tested and prevented egg-laying to the extent of 100 and 98 per cent., respectively, as compared with alcohol alone. In tests against the larvae in the following year, a colloidal suspension of DDT at 1 : 7,000,000 was as toxic as an alcoholic solution at 1 : 30,000 and proved the best larvicide so far found. DDT was not so effective, however, in preventing the deposition of viable eggs as some other materials. Laboratory tests in 1947–48 indicated that female fertility decreases with rising temperature between 30 and 39°C. [86–102·2°F.] but is not affected by relative humidities of 45–100 per cent. at these temperatures. It was further found in the next year that the preoviposition and incubation periods, the number of eggs produced and the time of their deposition are apparently controlled by temperature, though relative humidity affects the viability of the eggs and larval survival. The optimum was 90 per cent., and mortality in the field is probably high at lower humidities. Deposition of eggs at irregular intervals during the winter is doubtless possible. Field observations indicated that activity of the larvae begins at the end of September, and reaches a maximum at the end of January, with a smaller peak at the end of February. Increases in populations of larvae were followed after 3–4 weeks by similar increases in medium-sized adults. The larvae tended to ascend vertical objects, to migrate towards a diffuse light source and to congregate in groups. After seven days, about 99 per cent. of 25,000 released had not migrated more than 15 ins. from the point of liberation.

Investigations on bacterial oxidation of arsenical cattle dips were carried out in all three years, and various Gram-negative bacteria of the genus *Pseudomonas* capable of oxidising arsenite to arsenate [*cf.* **8** 204] in the presence of oxygen were isolated in 1947–48. Since growth in the presence of lactose, sucrose or glucose does not prevent oxidation, it is thought that the known effect of these carbohydrates in preventing oxidation in dips [*cf.* **32** 69] is through the stimulation of arsenate-reducing bacteria. Growth and oxidation were not depressed by copper sulphate (1 : 2,500), and sodium chloride at 4 per cent. had little effect. In the following year, tests on the prevention of oxidation by bacteria were carried out in small-scale model dips contaminated with faeces. Potassium cyanide at 65 parts per million arrested oxidation for six weeks in a dip already 29 per cent. oxidized ; in the same period, sufficient oxygen dissolved through a 5·5 mm. layer of liquid paraffin to permit 45 per cent. oxidation, and the percentage reached 82 in an untreated dip. This concentration of cyanide would be negligible toxicologically, but the treatment does not reduce arsenic already oxidised, as lactose and molasses do. Phenyl mercuric nitrate at 71 p.p.m. also completely arrested oxidation but is too costly for use.

In 1948–49, treatment of a tick-infested pasture with a colloidal suspension containing 0·1 per cent. DDT at 1·147 lb. p,p'DDT per acre with a power-spraying plant gave almost complete control of the larvae for 6–8 days, but the population had greatly exceeded its original density after 27 days. The cattle receiving continued cutaneous applications of DDT in oil [*cf.* **36** 118] showed no signs of poisoning in any year, and the residues in the milk were only about 3–4 parts per million in 1946–47. Calves produced in 1946–48 were unaffected and no abnormalities were detected in the original animals on slaughtering in 1948–49.

In 1948–49, insectary experiments on the prevention of body strike in sheep by *Lucilia cuprina* (Wied.) were continued, and various materials were tested for application to the tip of the fleece. DDT at 2 and 1 per cent. gave complete protection for several weeks, and BHC at 0·5 per cent. γ isomer was comparable with 1 per cent. DDT. Intermittent artificial rain totalling 17 ins. during 64 days did not affect the protective periods of DDT or BHC. DDT continued to give partial protection for long after some oviposition was permitted. Eggs were not affected by the insecticides, but BHC and its vapour were very toxic to young larvae. Toxaphene was much less effective. In a field trial in Queensland, 238 and 215 yearling sheep treated with DDT and BHC, respectively, at the end of March were protected from body strike in May and June, while 5·1 per cent. of untreated animals were affected. A lamb-marking dressing of boric acid, citronella and bentonite [*cf.* **36** 119] (known as Borocit) gave good results in each year. In tests in 1948–49, preparations containing dimethyl phthalate proved good but inferior, and the effect of dipping the rump in a proprietary preparation of BHC before docking was investigated. Over 50 per cent. of the docked tails were struck in the wounds, but there was no spread. Under the same conditions, Borocit was highly effective. In 1947–48, however, when infestation was severe, other protective measures were required, and for the prevention of normal crutch strike following marking, jetting with not less than 0·75 per cent. BHC gave protection for 3–4 weeks. Udder strike, which affected 10–15 per cent. of the ewes that had undergone the modified Mules' operation [**32** 142], occurred during a period of high fly activity that persisted during and after lambing. In tests against head strike, the polls and the bases of the horns of three groups of rams were jetted with a proprietary preparation of calcium arsenite and a dispersible BHC powder giving 0·1 or 0·2 per cent. γ isomer [*cf.* **36** 57]. During the next four weeks, BHC gave complete protection, while calcium arsenite resulted in 10 per cent. strike. Further investigations in 1946–47 on the method of inheritance of skin wrinkles in sheep [*cf.* **36** 119] showed that the characters of " wrinkling " and " plain body " depend on the action of many genes, among which those for " plain body " were dominant [*cf.* **35** 71], and it was also shown that whereas it would be relatively simple to evolve very plain or very wrinkled animals, control of intermediate types would be rendered difficult by their heterozygosity. Experimental matings have disclosed little, if any, relation between the appearance of Merino sires and the degree of wrinkledness in their progeny from first-cross heterozygous ewes.

It is stated in the third report that the validity of the taxonomic separation of *L. cuprina* from *L. sericata* (Mg.) [*cf.* **35** 100] was being re-examined. The adults can be separated by at least five characters and have different habitat preferences ; laboratory crosses were obtained only with difficulty. These facts, together with the frequent records of *L. cuprina* in strike wounds on sheep in Australia and the rare presence of *L. sericata*, indicate that the two species are distinct.

In an experiment in 1946–47, infestation by *Melophagus ovinus* (L.) and *Damalinia* (*Bovicola*) *ovis* (L.) persisted on sheep that were given a poor diet, but well-fed sheep that were similarly infested were free from both after three

months. In 1948–49, an oral dose of 0·5 gm. per kg. body weight crude BHC containing 13 per cent. γ isomer controlled *D. ovis* and gave considerable, but not complete, mortality of *Melophagus*, but caused severe nervous symptoms and loss of appetite. Higher doses killed some of the sheep, and lower ones gave no control of the louse. In small-scale trials against the sheep foot-louse, *Linognathus pedalis* (Osb.) in 1947–48, arsenic, rotenone, DDT and BHC were toxic to nymphs and adults. Only BHC showed effective residual toxicity, and none affected the eggs. In 1948–49, a combined spray and foot bath containing 0·007–0·15 per cent. γ BHC eradicated infestations.

The adjuvant effect of lubricating oil in pyrethrum sprays against the house-fly [*Musca domestica* L.] was found in the first year to be due to its relatively low volatility, which tends to decrease the rate at which the spray droplets diminish in size as the carrier solvent evaporates. In the second year, applications of measured doses in solution to individual house-flies showed that γ BHC was 3–5 times as toxic as DDT, which was seven times as toxic as pyrethrins.

Investigations were made in Queensland in 1946–47 on the bionomics of the Dawson River sandfly, *Austrosimulium* [*pestilens* Mack. & Mack. (**37** 123)]. It is a possible vector of worm-nodule (*Onchocerca*) in cattle, and in 1947–48, *O. gibsoni* was found endemic in cattle near Brisbane. *O. gutturosa* and *O. lienalis* may also occur in Queensland cattle, but the larvae of these three species are indistinguishable. Two unidentified filarial larvae were found during an examination of some 250 specimens of *A. pestilens*. In 1948–49, an application of p,p′DDT at 0·9 part per 10,000,000 to a stream near Brisbane killed larvae of *Simulium ornatipes* Skuse and *S. clathrinum* Mack. & Mack. for 50 yards downstream within 24 hours. Larvae did not reappear for 14 days.

Schwardt (H. H.). **Control of northeastern Livestock Parasites by Use of efficient Insecticides.**—*Agric. Chem.* **5** no. 3 pp. 33–35, 87–88, 4 figs. Baltimore, Md., 1950.

The greater part of this paper is concerned with the control of mange mites [*cf. R.A.E.*, B **38** 100] and lice [*cf.* **38** 59] on cattle in the north-eastern United States. In that region, dairy cattle, sheep and pigs are kept in warm quarters during the long winter, and this favours the development of ectoparasites. Tests in the winter of 1948–49 confirmed the usefulness of γ BHC (benzene hexachloride) against mange mites on dairy cattle [*cf.* **38** 101]. Over 100,000 such cattle were sprayed twice at an interval of 7–10 days with 1·5 lb. of a material containing 25 per cent. γ BHC per 100 U.S. gals. at 2 U.S. gals. per animal in a State-wide campaign in New York supervised by I. G. Howe. No instance of objectionable odour or flavour in the milk was recorded, and analyses of milk by L. B. Norton showed that residues were very low and did not persist long. The treatment gave adequate control until it was almost time to turn the animals out to pasture, and though it did not eradicate mange, many dairymen were so satisfied with its effect against both mange and lice that they expect to make it a routine each season, even if only for louse control.

Several years' work in New York on the control of the lice shows that thorough treatment of the whole herd as soon as infestation is first seen is the most effective measure. One application in the season is usually enough. Hitherto, dusts have been recommended in the north-east [**38** 60], but recent tests suggest that spraying just after the herds have been brought in for the winter is preferable. One application at 400 lb. pressure of 2 U.S. gals. per animal of a spray containing 1 lb. 5 per cent. rotenone, 4 lb. 50 per cent. wettable DDT or 1·5 lb. 25 per cent. γ BHC per 100 U.S. gals. was adequate.

Hypoderma spp. are not of great importance in dairy herds in the north-east. At least five applications of rotenone would probably be needed to give anything

approaching complete control as the presence of both *H. lineatum* (Vill.) and *H. bovis* (Deg.) prolongs the period when the larvae are in the backs of the cattle, but only one application about 1st April and a second about 1st May before the cattle are sent to pasture are practicable on young stock. In large-scale tests, in most of which a 1 per cent. dust was used, this schedule gave sufficient control to justify the expense and work, but it allows many larvae to develop in the late season. Doubling the concentration increased mortality by only 3 per cent. Tabanids seriously reduce milk production [*cf.* **38** 84], but no means of controlling them is known. Though they are susceptible to DDT and BHC, they complete their meal on sprayed animals before being affected. Repellents would have to be extremely cheap and long-lasting to be economic [*cf.* **38** 87].

Sheep in the north-eastern States are attacked by the sheep ked [*Melophagus ovinus* (L.)], lice [*cf.* **37** 162], blowfly larvae and nose bots [*Oestrus ovis* L.]. Several years' tests have indicated that rotenone is still the best material for dips to control the ked [*cf.* **38** 95]. Diluted in 100 U.S. gals., 8 oz. 5 per cent. rotenone will treat 50–100 sheep. Other materials give equally good control but at greater cost. A serious infestation by *Lucilia caesar* (L.) was controlled by one dipping in a suspension of 0·5 per cent. DDT. No effective measures against the nose botfly are known.

Power spraying with as little as 4 or 6 lb. wettable BHC powder (6 per cent. γ isomer) per 100 U.S. gals. killed lice and their eggs on pigs and greatly retarded mange, but it is believed that higher concentrations would be needed for the complete eradication of mange from a herd. There was no detectable odour or flavour in the meat or lard from an animal slaughtered three weeks after treatment with 4 lb. per 100 U.S. gals.

KEMPER (H. E.). **The Spinose Ear Tick and Methods of treating infested Animals.** —*Fmrs' Bull. U.S. Dep. Agric.* no. 980 (revd.) 10 pp., 5 figs., 1 ref. Washington, D.C. [1947.]

The main change in this revised version of an earlier bulletin [*R.A.E.*, B **7** 93] on the bionomics [*cf.* also **38** 96] and control of *Otobius megnini* (Dugès) on cattle and other domestic animals in the south-western United States, is the recommendation of two new ear dressings, one of which has already been noticed [**37** 202]. The other, which is known as Stock 1029 and is a mixture of 10 per cent. pyridine in an adhesive base consisting of 45 per cent. resin, 40 per cent. hydrogenated methyl abietate (Hercolyn) and 15 per cent. dibutyl phthalate, destroys the ticks effectively and prevents reinfestation for a considerable period. It is applied on a paint brush inserted well down into the outer ear and rubbed about to ensure coverage of the deep convolutions.

PAPERS NOTICED BY TITLE ONLY.

DE JONG (J. R.). **Field Method for the Determination of the Particle Size of Oil Mists.**—*Ann. appl. Biol.* **37** no. 3 pp. 516–526, 1 pl., 5 graphs, 4 refs. London, 1950. [See *R.A.E.*, A **39** 51.]

HEWLETT (P. S.) & PLACKETT (R. L.). **Statistical Aspects of the independent joint Action of Poisons, particularly Insecticides. II. Examination of Data for Agreement with the Hypothesis.**—*Ann. appl. Biol.* **37** no. 3 pp. 527–552, 2 graphs, 18 refs. London, 1950. [See *R.A.E.*, A **39** 52.]

LOWMAN (M. S.), GERSDORFF (W. A.) & KELLY (J. W.). **Effect of Drying Methods on Toxicants in Pyrethrum Flowers.**—*Soap & sanit. Chem.* **25** no. 9 pp. 118–121, 151, 10 refs., no. 10 pp. 135–136. New York, N.Y., 1949. [See *R.A.E.*, A **39** 53.]

COOP (I. E.) & MCLEOD (G. B.). **Sheep Dipping Trials with Derris, Bentonite Sulphur, D.D.T., and Benzene Hexachloride.**—*N.Z.J. Sci. Tech.* **30** (A) no. 5 pp. 292–304, 8 refs. Wellington, N.Z., 1950.

In the experiments described on the effectiveness of various dips against the sheep ked, *Melophagus ovinus* (L.), and the sheep louse, *Damalinia* (*Bovicola*) *ovis* (L.), in New Zealand [*cf. R.A.E.*, B **37** 83], the sheep were immersed for 30 seconds individually in a portable tank holding 50 gals. dip and then isolated in groups in pens. To conform with farming conditions, most sheep were dipped with 1–3 ins. wool. Keds and lice were counted before and 5–10 days after dipping and thereafter at monthly intervals, and, in some cases, the sheep were periodically artificially infested with keds to determine how long the insecticide in the fleece remained toxic.

Since derris suspensions had been found effective against the ked but were later shown not to afford complete control of the louse [*cf.* also **38** 197] and sometimes to cause temporary lameness in the sheep, they were further tested in 1943–46, with special reference to *Damalinia*. Complete initial control was given in all cases, but infestation recurred after 3 and 3–9 months with 0·5 lb. derris (4 and 7 per cent. rotenone content, respectively), and 12–18 months with 1·33–2·66 lb. derris (8·3 per cent. rotenone) per 100 gals. Coarse- and fine-woolled sheep treated with 2 lb. derris (5 per cent. rotenone) per 100 gals. and housed indoors were still free from lice after 12 months. Two untreated sheep that were heavily infested at the initial count became lightly infested after 3–6 months and then again heavily infested after 9 months. The percentage of rotenone in a sample of derris powder that was continuously exposed to light and air for 155 days fell from 4·2 to 3·1 ; it still controlled keds on unshorn sheep for over four months at 0·5 lb. per 100 gals. but its effect on lice was poor. In a test under farm conditions, an emulsified dip containing 0·01 per cent. rotenone from derris extract eradicated keds, and in a similar trial on a small scale the fleece remained toxic to them for four months. In tests of the lowest effective concentration of derris containing 3·3 per cent. rotenone, 0·5 and 0·2 lb. per 100 gals. gave complete control of keds initially but not after 6 and 3 weeks in the fleece, respectively, and 0·077 lb. gave incomplete control, some adults emerging from pupae and surviving.

In view of a claim from the United States that a dip prepared from a fused mixture of bentonite and sulphur (7 : 3) alone was toxic to keds and lice and afforded prolonged protection, a fused mixture (2 : 1) was prepared and tested at high concentrations, but was not satisfactory against either keds or lice. Since material obtained from the United States in 1946 contained rotenone, the original claim is thought to have been abandoned.

Various DDT dips were tested in 1946–47, the concentrations being given as pure DDT. Keds were completely controlled by dips of 0·03 or 0·045 per cent. DDT as an impregnated talc powder, 0·02 per cent. DDT from a commercial preparation of 50 per cent. DDT and wettable sulphur (1 : 4), 0·02 per cent. DDT from a ground mixture of DDT and derris (1 : 1), in which the DDT adhered to the derris and was dispersed with it in the water, and 0·1 per cent. DDT as an emulsified solution, though the last-named at 0·01 per cent. DDT was unsatisfactory [*cf.* **38** 198]. In all cases the control of lice was poor, infestation reappearing after 2–3 months. In a small-scale test, 0·02 per cent. DDT with wettable sulphur or 0·1 per cent. DDT as an emulsified solution remained effective in the fleece for six weeks and three months, respectively.

Dips of crude BHC (benzene hexachloride containing 12–13 per cent. γ isomer) were tested in the same years. Complete control of keds was given by 0·003–0·0125 per cent. γ BHC in an emulsified solution, 0·003 per cent. when the BHC was dispersed on derris in the same way as the DDT, 0·0015 per

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cent. from a dispersible powder of BHC and derris, and 0·0006–0·003 per cent. from a commercial powder containing 50 per cent. BHC on a solid dispersing agent, but not by 0·0003 per cent. from the last named. A trial with the dispersible powder at 0·003 per cent. γ BHC was carried out under farm conditions on newly-shorn, lightly infested ewes and unshorn heavily infested lambs. No keds were observed 8 or 67 days after dipping. The periods for which the insecticide in the fleece was toxic were 3 months, 9 weeks and less than 3 weeks for 0·003, 0·0012 and 0·0006 per cent. γ BHC as the dispersible powder, and 4 and 5–6 months for 0·005 and 0·0125 per cent., respectively, in the emulsified solution. All treatments gave complete initial kill of lice. No lice were found after 12 months on sheep treated with 0·003 per cent. γ BHC or more, or after eight months with 0·0012 per cent., but lice had reappeared and multiplied after four months with dips containing 0·0006 per cent. No lice were seen after six months on heavily infested sheep treated with 0·003 per cent. under field conditions.

The advantages and disadvantages of the various insecticides are discussed. The lameness caused by derris is unexplained. It appears a few days after treatment and rarely lasts for more than 2–3 weeks. No mortality occurs, but the sheep suffer a set-back. It has seldom appeared when the dips were used on the day of preparation and never following a dip prepared from derris extract. Similar but more sporadic lameness occurred in several flocks dipped in a commercial preparation of BHC and phenol.

Malherbe (W. D.). *Rickettsia canis* **Infection in Dogs in the Pretoria District.**—*S. Afr. J. Sci.* **43** pp. 271–276, 14 refs. Johannesburg, 1947.

The disease of dogs caused by *Rickettsia canis*, which is transmitted by *Rhipicephalus sanguineus* (Latr.) [*cf. R.A.E.*, B **25** 123], was first recorded from South Africa and Southern Rhodesia in 1938. The South African record was from the Kruger National Park. The disease was not heard of in South Africa outside the Park until April 1946, when examination of a dog that had died suddenly in the Pretoria district showed the presence of *Rickettsia canis* in the free monocytes. Within a month, a dozen cases were diagnosed. There was sometimes an intercurrent infection with *Piroplasma* (*Babesia*) *canis*. Rickettsiasis caused by *R. canis* is considered to be one of the most frequent causes of illness in dogs in Algeria. It occurs on the Mediterranean coast of France [*loc. cit.*], in the eastern Mediterranean, Uganda, Kenya, the Belgian Congo and India. Notes are given on diagnosis by means of smears of blood from the ear, which was found to be the most satisfactory method, and on symptomatology and treatment.

Schulz (K.) & Smit (J. D.). **Preliminary Report on Investigations carried out in Connection with a Disease affecting Stock in the Ngotshe District with special Reference to Nagana.**—*S. Afr. J. Sci.* **43** pp. 280–286, 7 refs. Johannesburg, 1947.

Heavy mortality among cattle in the Ngotshe District of Natal and the Piet Retief District of the Transvaal in late 1945 and early 1946 was found to be due to trypanosomiasis. Horses, mules, donkeys, cattle and dogs were also attacked by the disease, which was usually fatal. Two oxen, a dog and a cat were infected experimentally. The trypanosomes were polymorphic, and *Trypanosoma congolense* and some forms resembling *T. brucei* were identified. Pathological changes and symptomatology are discussed. Most of the cases occurred among cattle near large water courses to which many farmers had migrated with their stock on account of severe drought. The drought had also

caused game to congregate in the same areas. *Glossina pallidipes* Aust. was present on several of the affected farms and had apparently been spreading to the west along rivers.

James (M. T.) & Gassner (F. X.). **The immature Stages of the Fox Maggot,** *Wohlfahrtia opaca* (**Coq.**).—*J. Parasit.* **33** no. 3 pp. 241–244, 3 figs., 4 refs. Lancaster, Pa., 1947.

Keys are given to the larvae of all instars, pupae and adults of *Wohlfahrtia magnifica* (Schin.), *W. opaca* (Coq.) and *W. vigil* (Wlk.), the three myiasis-producing species of the genus, together with descriptions of the immature stages of *W. opaca*, which has attained considerable importance during recent years as a parasite of foxes and mink in the western United States and Canada [*cf. R.A.E.*, B **38** 62, etc.] and has also been known to attack man and dogs. The study of *W. opaca* was based on material from fox farms in Colorado.

Fox (I.). *Ornithodoros puertoricensis*, **a new Tick from Rats in Puerto Rico.**—*J. Parasit.* **33** no. 3 pp. 253–259, 3 figs., 22 refs. Lancaster, Pa., 1947.

Cooley concluded that many records of *Ornithodoros talaje* (Guér.) have been due to misidentification [*R.A.E.*, B **33** 149], and this probably explains why that tick has been recorded from such a large range of mammals, reptiles and birds and over such a wide area. Any reference to *O. talaje* should therefore be accompanied by a complete description of the tick intended. The original description shows that the true *O. talaje* was a large species that inhabited houses in Guatemala and attacked man at night. *O. rudis* Karsch agrees with this, but the author follows Cooley & Kohls [**32** 217] in maintaining it distinct until a full study is made. Also distinct from *O. talaje* is the new species here described from adults, larva and nymphs as *O. puertoricensis*. It was reared from larvae collected in Porto Rico from *Rattus norvegicus* and *R. rattus* in 1946, and a study of material in a rather poor condition labelled *O. talaje* from the Panama Canal Zone indicated that this may represent the same species.

Of 750 living rats collected in San Juan between January 1946 and January 1947, 191 were infested with 1–118 larvae each of *O. puertoricensis*. Breeding continued throughout the year. The degree of infestation indicates that members of the genus *Rattus* are the natural hosts of the larvae of this tick. It has been considered that *O. talaje* has small wild rodents as natural hosts and enters houses through the intervention of rats. However, all or nearly all the records of *O. talaje* on rats are from Panama and Colombia [*cf.* **21** 284, etc.], and since these may refer to *O. puertoricensis*, the theory is plausible that two species are involved, one with domestic rats and the other with wild rodents as natural hosts.

In the rearing experiments with *O. puertoricensis*, engorged larvae moulted after an average of three days. The first-stage nymph did not feed and moulted after an average of 6·8 days. The second, third and fourth nymphal stages lasted, respectively, 10·4, 12·5 and 14·3 days after engorgement. The moult following the third stage sometimes led to a fourth and sometimes directly to the adult stage. Nymphs survived for several months without food. A list is given of the six Ixodids recorded from Porto Rico. This is the first record of an Argasid.

Wharton (G. W.). **Studies on North American Chiggers. 1. The "*akamushi*" Group.**—*J. Parasit.* **33** no. 3 pp. 260–264, 1 fig., 10 refs. Lancaster, Pa., 1947. **2. The Subfamilies and *Womersia strandtmani* n. g., n. sp.**—*T. c.* no. 4 pp. 380–384, 1 fig., 6 refs.

In the first of these two parts, the author deals with *Trombiculæ myotis* Ewing, the only known representative in the United States of the group of species of *Trombicula* (here termed the "*akamushi*" group) to which all the proved vectors of tsutsugamushi disease belong [*R.A.E.*, B **37** 124]. A detailed redescription of it is given, and its likeness to the very closely related *T. akamushi* (Brumpt) is discussed. These two species can be separated only by the ornamentation on the scutum. The presence of a member of the *akamushi* group in the United States may be of practical importance, as it may harbour the rickettsia that causes tsutsugamushi disease. Even if it does not, but can be infected with the rickettsia, it will be useful for experimental purposes. As it infests bats and has been collected only twice, there appears to be little danger of its carrying tsutsugamushi disease to man.

In the second part, the family Trombiculidae [**34** 36], previously separated from the Trombidiidae by characteristics of adult morphology and larval habits, is defined on the basis of larval morphology. The diagnosis excludes the Hemitrombiculinae from the family. Ewing's interpretation of the remaining three subfamilies is modified, and a new subfamily, Apoloniinae, is erected to include the genera *Apolonia* and *Womersia*, n. A key to the subfamilies is given. *Womersia* is erected for *W. strandtmani* sp. n., which is described from a pelican in Texas.

Diller (W. F.). **Notes on Filariasis in Liberia.**—*J. Parasit.* **33** no. 4 pp. 363–366, 3 refs. Lancaster, Pa., 1947.

Dissection of 649 females of *Anopheles gambiae* Giles collected in the neighbourhood of Roberts Field, Liberia, in May–September 1943 showed six of them to contain filarial larvae consistent in size with infective larvae of *Filaria* (*Wuchereria*) *bancrofti* and believed to belong to that species. The malarial infection rate (oöcysts and sporozoites) in the same mosquitos was 3·4 per cent. *A. gambiae* constituted over 90 per cent. of the mosquitos collected at Roberts Field. Numerous cases of elephantiasis were observed among the Liberian population. Two cases of infection with *Filaria* (*Acanthocheilonema*) *perstans* and 14 with *F. bancrofti* were detected in 2,134 Liberians from blood smears largely taken in the daytime and examined by the thick blood-film technique. In four nocturnal surveys made in five villages, 84 out of 935 people (8·8 per cent.) were found to be infected. In one case, the species involved was *F. perstans* and in all the others *F. bancrofti*. Examination according to age-groups showed that infection was apparently acquired during childhood and continued into adult life. Most of the cases were asymptomatic.

Griffiths jr. (J. T.). **A further Account of Tsutsugamushi Fever at Sansapor, Dutch New Guinea.**—*J. Parasit.* **33** no. 4 pp. 367–373, 2 figs., 9 refs. Lancaster, Pa., 1947.

Rats were trapped alive with their attached Trombiculids in various environments at Sansapor, Netherlands New Guinea, where an epidemic of tsutsugamushi disease occurred among United States troops in 1944 [*R.A.E.*, B **35** 164]. Most of a sample of rats examined were identified as *Rattus concolor manoquarius*, others probably represented a local form of *R. ringens ratticolor*,

and there was an undetermined species of *Melomys*. *Trombicula deliensis* Walch, the only species of *Trombicula* taken, was the commonest mite and was found on rats from all environments. Five species of Trombiculids of other genera were also found, mainly in the native gardens and on and near the uncleared beach. *T. wichmanni* (Oudm.) [*cf.* **38** 161, 191], which was not found on the rats, was taken in some numbers from five men, who became infested while working in uncleared rain forest. It was the only species found attached to man. Rats were quite plentiful in the cleared areas, but they had fewer mites than those from uncleared parts. Only three rats were taken in three traps in uncleared rain forest.

A list is given of species of grass identified from the environment in which 500 cases of tsutsugamushi fever had occurred [**35** 164]. Rats of the *concolor* group were plentiful and mites abundant. The only mites taken in boot collections [*cf.* **34** 141] were a few individuals of *Schöngastia blestowei* Gunther. The peculiarities of the incidence of tsutsugamushi disease in one battalion are discussed. Though living in apparently identical environments and not far apart, two of the five companies had a high infection rate while two had practically no cases. A tentative explanation is that an infected female mite would probably lay its eggs close together, so that the infected larvae of the next generation would be found within a small area.

PRITCHARD (A. E.). *Hoplopleura oenomydis* **Ferris, a Louse found on domestic Rats in the United States.**—*J. Parasit.* **33** no. 4 pp. 374–375, 5 refs. Lancaster, Pa., 1947.

Records of the occurrence of *Hoplopleura oenomydis* Ferris in various parts of the world are cited, and the species, with which *H. pacifica* Ewing [*R.A.E.*, B **17** 19] has been found to be identical, is shown to have a very wide distribution and to occur on a number of murine hosts. Between December 1945 and December 1946, 4,172 examples of it were found on 101 out of 601 rats trapped alive at Jacksonville, Florida, whereas no examples of *H. hirsuta* Ferris were seen. It is therefore suggested that Rumreich & Wynn's statement that 35·9 per cent. of the lice taken on rats in Jacksonville in a survey made in 1934 were *H. hirsuta* [**35** 10] was based on a misidentification, as this approximated to the percentage of *H. oenomydis* found in 1945–46. *H. oenomydis* is known to have been collected from domestic rats in one other locality in Florida and in five other States.

BAILEY (W. S.). **Observations on the Rôle of** *Tenebrio molitor* **as an intermediate Host for** *Hymenolepis nana* **var.** *fraterna*.—*J. Parasit.* **33** no. 5 pp. 433–434, 6 refs. Lancaster, Pa., 1947.

In a test in Alabama in which five adults of *Tenebrio molitor* L. were fed on gravid segments of *Hymenolepis nana* var. *fraterna* obtained from a wild mouse (*Mus musculus*), no cysticercoids were found in beetles examined 4 and 5 days later but two examined after 12 days had 31 and 10 cysticercoids, respectively [*cf. R.A.E.*, B **16** 230]. Two strobilae of *H. nana* were found when a white mouse was killed 12 days after feeding on the cysticercoids. In the second test, 12 adults of *T. molitor* were fed on gravid proglottids from worms in a white mouse received from the University of North Carolina. Beetles examined 7, 9 and 12 days later were negative, but one of six examined after 14 days harboured two cysticercoids and one of two examined after 16 days harboured 15. A mouse fed on ten of them developed infection. Five adults of *T. molitor* were fed on gravid proglottids from these worms, and several cysticercoids were recovered from one of them two weeks later.

Moore (D. H.). **Effectiveness of Piperonyl Butoxide and Pyrethrum as a practical Treatment for Hog Lice.**—*J. Parasit.* **33** no. 5 pp. 439–443, 1 fig., 4 refs. Lancaster, Pa., 1947.

In 1947, experiments were carried out at Baltimore, Maryland, to determine the effectiveness against *Haematopinus suis* (L.) of technical piperonyl butoxide (containing not less than 80 per cent. of 3,4-methylenedioxy-6-propylbenzyl butyl diethylene glycol ether and not more than 20 per cent. of other closely related compounds) combined with pyrethrins in hog oil (viscosity 70–80 per cent. Saybolt at 100°F. with an unsulphonated residue of 84 per cent.). In laboratory tests, pieces of cloth were sprayed with the hog-oil solution containing various concentrations of the test substances at the rate of 5 ml. per sq. ft., and placed in beakers with ten lice after the oil film had dried [*cf. R.A.E.*, B **34** 44]. The lice were exposed to the treated cloth for 15 minutes, after which they were kept on untreated cloth in clean beakers for 24 hours at 30±2°C. [86±3·6°F.] and 60 per cent. relative humidity. The lice were exposed 1, 3, 4, 5, 7 and 11 days after application. All concentrations are per 100 ml. oil. The results showed that complete kills were given after 1 day by 2 gm. piperonyl butoxide alone and after 1 and 3 days by 2 or 0·5 gm. piperonyl butoxide with 0·05 gm. pyrethrins. A concentration of 1 gm. piperonyl butoxide with 0·1 gm. pyrethrins gave complete kill after 3, 4 and 7 days, but not after 1, 5 and 11 days. Treatment with hog oil alone permitted lice to survive in all tests, and a white mineral oil (viscosity 50–55 Saybolt at 100°F.) usually gave no mortality.

In field tests, sprays of 0·5 gm. piperonyl butoxide and 0·05 gm. pyrethrins per 100 ml. hog oil were applied to heavily infested pigs in barnyards by directing the stream down the middle of the back at the rate of 0·25 oz. per animal. Five young pigs weighing about 30 lb. each were freed from infestation and remained free for two weeks, after which a few newly hatched nymphs were observed. After three weeks, however, only one small nymph was found, and no living lice or eggs were found after four weeks. Rather older pigs showed no lice for a week after treatment, but a few newly hatched nymphs were found in the second week. A second application then kept the animals free for a month. A few lice survived on one of two very large sows a week after treatment, when a further 0·5 oz. solution was applied. Weekly examinations for a month afterwards revealed no living lice or eggs. A further test was carried out on 30 heavily infested pigs in a corral of about 0·25 acre containing several trees. A square post was set in the ground and four layers of burlap were wrapped round it and securely nailed. The solution was then sprayed on the burlap at 3·25 oz. per sq. ft. In a short time all the pigs were seen to rub against the post, and examination on the following day and during the next four weeks showed no living lice on any of them. This method is recommended for pigs in a corral, and the burlap should be sprayed every 3–4 weeks. Small groups of animals in pens should be sprayed individually and the treatment repeated two weeks later, after which a light spray every month will maintain protection.

Olsen (S. J.) & Roth (H.). **On the Mite *Cheyletiella parasitivorax*, occurring on Cats, as a facultative Parasite of Man.**—*J. Parasit.* **33** no. 5 pp. 444–445, refs. Lancaster, Pa., 1947.

In view of Cooper's opinion that *Cheyletiella parasitivorax* (Mégn.) is harmless to mammals [*R.A.E.*, B **38** 190], the authors cite two recent instances in Denmark of dermatitis in man resulting from contact with cats infested by this mite [*cf.* also **7** 172]. In one of them, a heavily itching papulous eczema persisted for a year in all three members of a family, but disappeared when a

heavily infested cat was destroyed. A similar condition appeared in members of another family that owned seven cats and kittens all found to be infested by *C. parasitivorax* in the fur and *Otodectes cynotis* (Hering) in the ears. The eruptions were worse when the cats had been in the beds, but improved within 8–14 days when the owners were absent from home. Other persons who came in contact with the cats also developed symptoms. The cats became free from mites when one of them was treated with DDT powder and the rest with a solution of derris, and the owners had no new eruptions when they allowed the cats to sleep in their beds again. Moreover, the cats no longer scratched themselves whereas they did so frequently when they were infested.

In a preliminary experiment, an example of *C. parasitivorax* produced two red, slightly elevated spots when placed on the forearm for a few minutes. These reactions, however, were much weaker than those of the above cases.

Hall (D. G.) & Bohart (G. E.). **The Sarcophagidae of Guam (Diptera).**—*Proc. ent. Soc. Wash.* **50** no. 5 pp. 127–135, 6 figs. Washington, D.C., 1948.

Keys are given to the adults, puparia and third-instar larvae of the six species of Sarcophagids known to occur on Guam, based on collections of about 65,000 specimens made in 1944 (after the attack on the island in August) and in 1945 and 1946. All belong to the genus *Sarcophaga*, and two are described as new. One of these, *S. gressitti*, was taken on corpses and reared from them, but it was restricted to the beaches and neither it nor the other new species, *S. stricklandi*, which occurred in jungle and was infrequent, is thought to have much public-health significance. *S. dux* Thoms., *S. ruficornis* (F.), *S. knabi* Parker and *S. peregrina* (R.-D.) with *Chrysomyia rufifacies* (Macq.) bred in large numbers in human and animal remains and *S. knabi* and *S. dux* as well as *C. megacephala* (F.) in human excrement. *S. knabi* is the most abundant Sarcophagid on Pacific islands where the pig population is high and is probably the most abundant on Guam. Its larvae were frequently found in blood-soaked blankets at evacuation hospitals, and it is believed to be the only species of *Sarcophaga* recovered from cases of human myiasis on the island. It is considered an important factor in public health because of its association with excrement of carnivorous animals and tendency to produce myiasis. *S. dux* is the next most abundant and important species and was also frequent in blood-soaked blankets.

The distribution from aeroplanes of a spray of 5 per cent. DDT in fuel oil over army installations and their surroundings in October and November 1944, mainly for the control of *Musca sorbens* Wied., reduced the whole fly population in the treated area to a very low level for several months, and a second application to the whole island about a year later had similar results.

Bruce (W. N.) & Decker (G. C.). **House Fly Tolerance for Insecticides.**—*Soap & sanit. Chem.* **26** no. 3 pp. 122–125, 145–147, 7 figs., 6 refs. New York, N.Y., 1950.

The studies described were designed to elucidate certain problems connected with the acquired tolerance of *Musca domestica* L. to insecticides. The flies used were chiefly of a susceptible laboratory strain. Treatment of the adults alone was not sufficient to produce a strain highly resistant to DDT during the period of observation, but treatment of larvae and adults greatly intensified selection and inbreeding and highly resistant strains were produced. There is some evidence that the contamination of breeding media has contributed to the development of insecticide-resistant flies in nature, and an instance is recorded in which *Psychoda alternata* Say acquired resistance successively to DDT and chlordan applied to the sewage filter beds in which it was breeding.

In the experiments, adults were treated by topical application of solutions in acetone to the thorax, and larvae by adding the insecticides to the standard

breeding medium. The maximum rates at which they could safely be added at first were, in parts per million, 80 for DDT, 320 for methoxy-DDT, 160 for lindane [at least 99 per cent. γ benzene hexachloride], 5 for chlordan, and 1·2 for dieldrin (1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene). Further chemicals tested were toxaphene, a mixture of piperonyl butoxide and pyrethrins (10 : 1), and diethyl p-nitrophenyl phosphate. As a strain became more tolerant, both larvae and adults were exposed to higher dosages, and when the strains became highly resistant, the larvae tolerated over 200 times as much toxicant as susceptible larvae.

The following is largely based on the authors' conclusions. Intensive selection and inbreeding resulting from exposure of adults and larvae produced strains showing at least some degree of tolerance for all the chemicals tested. Generally, the acquisition of tolerance is slow during the first several generations and then increases rapidly until resistance is definitely established. Flies highly resistant to one chemical become resistant to others more readily than do susceptible strains. Under the pressure of repeated exposure to some insecticides, resistance of flies may rise to a level where the species can be maintained in a heavily treated environment. If no outbreeding is allowed, house-fly strains of low or high resistance to DDT tend to retain their resistance at a constant level for as many as thirty generations in the complete absence of DDT. Strains highly resistant to one insecticide usually show a noticeable tolerance for other insecticides, but this varies. For instance, DDT-resistant strains were significantly tolerant of methoxy-DDT, but the strain highly resistant to methoxy-DDT showed very little tolerance for DDT. The acquisition of some tolerance to piperonyl butoxide and pyrethrins was accompanied by almost equal resistance to the other insecticides tested. In this case, the resistance developed appears to be of a non-specific type. Some toxicants do not produce tolerance changes as readily as others. A strain of house-flies showing a moderate level of tolerance for most materials tested was produced by exposing a strain resistant to methoxy-DDT to a mixture of DDT, chlordan, lindane and toxaphene.

To retard the development of resistance in the field, deposits of chemicals for the control of adult flies should be applied in a manner that will not contaminate fly-breeding media. If larvicides are to be applied, they should not be chemically related to the insecticide used to give the toxic deposit for adult control. Resistance inheritance factors are carried by both sexes. Crosses result in physiological blends of resistant characters which, in the absence of DDT, persist through as many as 15 generations of inbreeding without measurable changes. Resistance to DDT in house-flies on a large number of Illinois farms is shown to have reached a point where the use of other insecticides is considered desirable. The onset of resistance to DDT and other insecticides should be watched for, and the insecticide used should be changed before tolerance to it has become so widely diffused that it cannot be reduced by cross-breeding with susceptible individuals, and so intense that resistance to other insecticides would be rapidly built up.

STARR (D. F.), FERGUSON (P.) & SALMON (T. N.). **Toxicity of a synthetic Pyrethrin.**—*Soap & sanit. Chem.* **26** no. 3 pp. 139, 141, 143, 4 refs. New York, N.Y., 1950.

The following is based on the authors' summary. The results are given of tests to determine the toxicity to warm-blooded animals of the completely synthetic allyl homologue of cinerin I, which is here referred to as devinyl-pyrethrin I (DVPy I) [and is also known as allethrin (*cf. R.A.E.*, B **38** 208)]. Neither rats receiving 0·2 per cent. of the ester in their diet nor their offspring

showed any evidence of being harmed over a period of 24 weeks, and they were of approximately the same size as untreated animals at the end of that time. Inhalation of and contact with a 1 per cent. aerosol spray in large amounts did no apparent damage to rats exposed to it for 30 minutes a day on six days weekly for 22 weeks, and the rate of growth of new-born rats that were subjected to this treatment was the same as that of untreated ones. In all, 112 rats were fed on or sprayed with the compound.

Examination of the internal organs of treated rats showed no gross pathology, and microscopic examination of the organs showed no abnormalities that could be correlated with treatment.

HARTZELL (A.). **Additional Tests of Plant Products for insecticidal Properties and Summary of Results to Date.**—*Contr. Boyce Thompson Inst.* **15** no. 1 pp. 21–34, 54 refs. Menasha, Wis., 1947.

The author gives some results obtained during further studies of the insecticidal properties of plants [*cf. R.A.E.*, A **28** 515; **30** 286; B **33** 24], in which 135 species and varieties were tested against larvae of *Culex fatigans* Wied. (*quinquefasciatus* auct.), and summarises the results obtained during the whole investigation. Of a total of 400 plant products tested against larvae of this mosquito, the most toxic, with (in brackets) the median lethal doses expressed as parts original dry material per million, were an acetone extract of balm of Gilead [*Populus* sp.] (5·8), crude filicin (11), and acetone extracts of *Echinacea* (16), cubeb [*Piper cubeba*] (24), black pepper [*Piper nigrum*] (29), seeds of *Pinus taeda* (34), seeds of *P. virginiana* (56), seeds of ladino clover (*Trifolium repens latum*) (90), whole plants of *Lychnis coronaria* (135), and the seeds and leaves of *Koelreuteria paniculata* (245).

SYNERHOLM (M. E.), HARTZELL (A.) & CULLMANN (V.). **Pyrethrin Extenders.** —*Contr. Boyce Thompson Inst.* **15** no. 1 pp. 35–45, 10 refs. Menasha, Wis., 1947.

Data obtained in tests of the value of the sulphoxides and sulphones formed by oxidising addition products (thioethers) of mercaptans and safrole or isosafrole as activators for pyrethrins in sprays against *Musca domestica* L. [*cf. R.A.E.* B **37** 159] are given, together with accounts of the methods of preparing them and information on the structure of the intermediate thioethers. The materials were tested in kerosene solution by the Peet-Grady procedure [*cf.* **37** 5], all spray quantities being given per 100 ml. solution. In the first experiment, sulphoxides and sulphones were used at 0·1 and 0·2 gm., respectively, with 0·0125 gm. pyrethrins and compared with the pyrethrins alone and with the OTI (Official Test Insecticide). The mortality percentages after 24 hours given by a series of 11 sulphoxides derived from addition products of safrole and mercaptans with, in brackets, that given by the OTI were 19–61 (36–55) and those from eight derived from isosafrole-mercaptan products were 28–70 (45–54). The corresponding figures for 12 sulphones derived from safrole-mercaptan and 12 from isosafrole-mercaptan products were 17–59 (37–50) and 21–76 (37–50), respectively. The percentage mortality for pyrethrins alone in both series of tests was 10 (50). The sulphones are less soluble in kerosene than the sulphoxides. In a further test, solutions containing pyrethrins alone and pyrethrins with eight activators were compared. The activators were the sulphoxides and sulphones derived from the addition products of n-octyl mercaptan with isosafrole and n-octyl mercaptan with 1-(3,4-methylenedioxyphenyl)-1-chloropropane (also referred to as isosafrole hydrochloride), the corresponding thioethers, piperine and piperonyl butoxide.

When used at 0·5 gm. with 0·05 gm. pyrethrins, the sulphones, sulphoxides and piperonyl butoxide all gave percentage mortalities exceeding 92, and piperine gave 91 per cent. mortality at 0·25 gm. with 0·025 gm. pyrethrins, but the intermediate thioethers did not give more than 65 per cent. at 0·5 gm. with 0·05 gm. pyrethrins. Pyrethrins alone at 0·05 gm. gave 32 per cent. mortality.

The two sulphoxides used in this experiment were not toxic to white rats when incorporated in their diet at a concentration of 0·5 per cent. over a period of three weeks.

Hocking (B.), Richards (W. R.) & Twinn (C. R.). **Observations on the Bionomics of some northern Mosquito Species (Culicidae : Diptera).**—*Canad. J. Res.* (D) **28** no. 2 pp. 58–80, 2 pls., 7 figs., 16 refs. Ottawa, 1950.

The following is based on the authors' summary. As a result of studies at Churchill, Manitoba, in 1947 [*cf. R.A.E.*, B **37** 166] and 1948, the Culicids present there are known to comprise ten species of *Aëdes*, two of *Culiseta* and four Chaoborines. Evidence is adduced that two species may have been confused under the name *A. communis* (Deg.), and a method is suggested for separating some of the black-legged species of *Aëdes* without using larval characters or scaling. Some observations on larval habits and habitats, seasonal development, species associations, temperature relationships and natural enemies are given. The Chaoborine larvae appear to be important predators of *Aëdes* larvae, consuming large numbers in the insectary, and are themselves preyed on by the larvae of Dytiscid beetles. Rearing methods used in the field and in the insectary are described. Seasonal changes in numbers, species composition and activity of the adult population are studied, and quantitative estimates of the influence of meteorological factors on activity are made. The only factors showing any influence were saturation deficiency, cloudiness and wind. The well-known intensity of mosquito attack immediately before thunderstorms can be explained as the combined effect of low wind speed, cloudiness and low saturation deficiency. Mating habits of some of the species of *Aëdes* are described, and the feeding habits of the females, which take both nectar and blood, are discussed and illustrated. Observations on the development and number of eggs of some species are recorded.

Mer (G.), Birnbaum (D.) & Aioub (A.). **The Attraction of Mosquitoes by Human Beings.**—*Parasitology* **38** no. 1–2 pp. 1–9, 3 refs. London, 1947.

The stimuli that guide female Anophelines to their source of food have been studied in the past [*R.A.E.*, B **25** 171, etc.] without definite conclusions being reached. The authors believe that three phases are distinguishable : attraction to the host's shelter, attraction to the host itself, and stimulus to feed. The study here described was concerned with the second aspect, as manifested by the attraction of man for females of *Anopheles maculipennis* var. *sacharovi* Favr (*elutus* Edw.) at a limited distance. The mosquitos were in cages measuring 180×60×60 cm., which were screened on all sides and could be divided into three sections, to facilitate counting, by screens dropped into the cage at 20 cm. from each end. The man serving as bait was usually 30 cm. from one end of the cage, facing either towards it or away from it, and sometimes his breath was led from the room in a tube. In some tests, a fan was used beyond the bait. The detailed results of eight series of experiments are given in tables, and their statistical significance is examined in appendices by R. Bachi (pp. 5–9). They showed that a man facing the cage exercises a strong attraction, and about the same degree of attraction is exerted by the breath expired by a man outside the room but led into it in a tube. If the man was not facing the

cage or if his breath was led outside, there was no attraction. An air current directed towards the cage past the whole body or an arm caused some attraction to be exerted in circumstances in which breath played no part, thus showing that it is not the expired air alone that is attractive. When the subject was beneath the cage, attraction was of medium intensity, whether the breath was led out of the room or not, probably through the attractive factor being carried upwards with the column of warm air rising from the body.

MILNE (A.). **The Ecology of the Sheep Tick, *Ixodes ricinus* L. Some further Aspects of Activity, seasonal and diurnal.**—*Parasitology* **38** no. 1–2 pp. 27–33, 3 figs., 7 refs. London, 1947. **The Infestations of Hill Sheep.**—*T. c.* pp. 34–50, 6 figs., 14 refs.

The first of these two papers comprises further information on the seasonal activity of *Ixodes ricinus* (L.) in Britain [*cf. R.A.E.*, B **33** 165] and a note on day-time activity as compared with night-time. The studies on seasonal activity were designed to show whether curves of activity based on blanket-dragging [**33** 166, etc.] are reliable and whether activity times for any stage differ on different hosts [*cf.* next abstract]. Curves based on weekly counts of adult female ticks on sheep and all stages except adult males on rabbits, skylarks and meadow-pipits on the same pasture in northern England and of females on sheep, red deer and blue hares in Scotland were similar in form and timing. With these animals, therefore, there was no indication of any marked effect of host species on activity. Adult females were not found on the birds and were rare on the rabbits. The finding of similar numbers of ticks on two hedgehogs taken on the same farm on 15th June (13 nymphs and 94 larvae) and 11th September (13 nymphs and 88 larvae) in 1944, whereas blanket drags yielded about five times as many nymphs in mid-June as in September is unexplained. Superficial examination of sheep confirmed the findings of the blanket counts. Additional data on differences in seasonal activity between stages showed that the curves for nymphs and adult males and females are usually similar and concurrent [**33** 166], but nymphs may occasionally have their peak 2–3 weeks later than adults. The larval counts on rabbits and small birds in 1944 confirmed the conclusion drawn from blanket drags in 1941–43 that the peak of larval activity is some weeks later than the peak of female activity. Observations made in northern England in 1944 showed that ticks are active during darkness but considerably less so than in daylight. This diurnal fluctuation in activity seemed to follow fairly closely the diurnal fluctuation in atmospheric temperature.

The investigations described in the second paper were concerned with the factors influencing infestation of sheep by *I. ricinus* and the distribution of infestation on them. The following is largely the author's summary. In general, female ticks infest the hairy parts of the sheep (head and legs), the comparatively bare parts (axillary and inguinal regions) and certain woolled areas (chiefly the short-woolled margins of the hairy and bare areas, though some attach in the long wool of the lower neck, chest and shoulders). They do not attach in the long wool of withers, back, rump and flanks. The relation of standard counts (all ticks on the fore-end of the body as far back as the posterior border of the axillae [**32** 105]) to total counts was very steady. Standard count $\times 1{\cdot}185$ should approximate to total count at any time of year. More female ticks attach on the head than on the axillary region and more on the axillary than on the inguinal region. Different tick stages tend to attach in different zones of the same regions, the larvae attaching nearest the presumed points of arrival on the sheep and the adults furthest from them. On a hill pasture where the main tick activity occurs in spring only, the average totals of female ticks carried per annum by ewe, hogg (sheep 6–12 months old) and

lamb were in the proportions 8 : 6 : 1. Host size is thought to be the chief governing factor. Under existing conditions on hill farms in northern England, the highest total weekly count of female ticks (spring peak) on a ewe usually averaged 100–150, with an extreme individual limit of about 300. About five times as many ticks are carried per ewe over the entire spring season. On heavily infested hill pasture stocked at the rate of one sheep to 1–5 acres, it was found that typical flocks feed 100–600 female ticks per acre per annum. The densest sheep stocking results in the highest tick density. For every female tick, about eight nymphs fed on sheep in one season.

The better the condition of a sheep, the less bare of wool and apparently (to touch and sight only) the more greasy, the lower is the tick infestation. Among sheep of any age group on one grazing, there is considerable range in weekly infestation, but individuals tend to keep their relative positions consistently in this range. There was no evidence that highly infested ewes tended to have highly infested lambs. Sheep differing markedly in infestation failed to show differences in most physical and physiological characters of body form and body surface. Notably, there was no indication of significant differences in fleece greasiness. Fleece humidity was not studied. Apparently, the only characteristics associated with lighter infestation in Blackfaced sheep are coarse fleece hair and little clearance between fleece tips and ground, which have doubtful and minor effects, respectively. The most important factor in individual differences of infestation within an age group is probably individual activity, the number of ticks picked up being related to the amount of ground covered in a given time.

EDWARDS (E. E.) & ARTHUR (D. R.). **The seasonal Activity of the Tick, *Ixodes ricinus* L., in Wales.**—*Parasitology* **38** no. 1–2 pp. 72–85, 12 figs., 16 refs. London, 1947.

The studies described were made on hill and lowland grazings in South Wales in 1944 and 1945 to elucidate certain aspects of the ecology of *Ixodes ricinus* (L.) with a view to instituting control measures involving improvement of grassland [*cf.* *R.A.E.*, B **37** 193] and treatment of cattle, which are the preferred hosts in that region [**37** 55–56]. The following is largely based on the authors' summary. There were usually two peaks of female activity, one in spring and the other in autumn [**37** 56]. On an experimental area, divided into eight plots, on the Margam Moors, Glamorgan, significantly varying populations were found by blanket dragging in 1945 to be present on the different plots, although the peak of activity on all of them was attained at about the same time. The seasonal activity of nymphs and larvae was essentially the same as that recorded for northern England by Milne [**33** 165–166 ; *cf.* also **39** 43]. There is reason to believe that in central Wales there is a single summer peak of activity [*cf.* **33** 166]. The seasonal activity curves of males, females and nymphs as determined by blanket draggings were similar and concurrent. The sex ratio is subject to variation from year to year with the females usually predominant.

The engorgement period of female ticks on cattle was 7–13 days. A distinct preference was shown for the hind region of the cattle. The differences in the mean populations of ticks on cattle of six different breeds were not statistically significant. Density of ticks and fecundity of the females were not correlated with the reproductive condition of cows to which they attached [*cf.* **28** 236]. The tick populations on sheep pastured on the same ground as heavily infested cattle were very low. The seasonal activity of female ticks on horses followed the same general trend as on cattle.

Muspratt (J.). **Note on a Ciliate Protozoon, probably** *Glaucoma pyriformis*, **parasitic in Culicine Mosquito Larvae.**—*Parasitology* **38** no. 1–2 pp. 107–110, 6 refs. London, 1947.

Fixed smears containing two forms of a ciliate parasite (types A and B) collected from the haemocoele of mosquito larvae in tree-holes at Livingstone, Northern Rhodesia [*R.A.E.*, B **37** 32] were stained and examined by V. Lewis. Type A appeared to correspond in nuclear structure with the ciliate figured by Keilin as *Lambornella stegomyiae* [**9** 190]. Lewis is inclined to agree with C. M. Wenyon that this is a synonym of *Glaucoma pyriformis*, but examination of the cytostome in the living ciliates would have to precede a definite decision. The nuclear structure of type B appears to be the same as that of type A, and it is concluded that the two are different forms of the same ciliate. Lewis suggests that type B is the organism in a pre-encystment stage. The author has dissected out type B in a living state from the adult mosquito, so it is possible that it encysts in the adult and is carried from one tree hole to another in this way. It may, however, be a degenerate form that develops in an unsuitable host. In nature at Livingstone, the most suitable host is the larva of *Aëdes fulgens* (Edw.), because the type-A ciliates have to escape by the rupture of the anal papillae before the host dies, and this rupture occurs most frequently in parasitised larvae of *A. fulgens*. The free-living organisms encyst on the cuticle of the larvae, usually just after these have moulted, and penetrate into the haemocoele before the cuticle hardens. Laboratory-bred larvae became infected within a few days of the release of the ciliates from the host [*cf.* **9** 190]. Stages in the penetration of the cuticle and the formation of cuticular resting cysts were observed. When only fully grown larvae were available, the ciliates encysted on these, though they could seldom enter the haemocoele. Larvae of *A. aegypti* (L.) were used in laboratory experiments but proved unsuitable hosts, as the anal papillae do not rupture easily and the reproductive power of the ciliates degenerated when they were transmitted from larva to larva of this species only. A diagram is given of a suggested life-cycle.

Attempts to infect Anopheline larvae (*Anopheles gambiae* Giles and *A. funestus* Giles) were unsuccessful, though the ciliates encysted on the cuticle. One or two entered the haemocoele of a larva of *A. funestus*, but only one survived for any time and it did not reproduce.

G. pyriformis has not been regarded as naturally adapted to a specifically parasitic mode of life, though it has been shown that individuals of a free-living strain readily became facultative parasites when injected into certain insects.

Feldman-Muhsam (B.). **Resistance of Larvae and Nymphs of** *Hyalomma savignyi* **Gerv. to various Conditions of Temperature and Humidity.**—*Parasitology* **38** no. 3 pp. 111–115, 2 figs., 6 refs. London, 1947.

The length of life of the unfed larvae and nymphs of *Hyalomma savignyi* (Gerv.) was investigated in Palestine [*cf. R.A.E.*, B **37** 212] at all combinations of relative humidities of 20, 50, 80 and 95 per cent. and temperatures of 17·5, 30 and 37°C. [63·5, 86 and 98·6°F.]. Length of life varied directly with humidity and inversely with temperature, both stages being much more sensitive to dryness than to temperature. The mean and (in brackets) maximum lengths of life of larvae varied from 1·25 (2) days at the lowest humidity and highest temperature to 162·6 (241) days at the lowest temperature and highest humidity. The mean (and maximum) lengths of life of the nymphs varied from 6·8 (10) days at the highest temperature and lowest humidity to 149·2 (246) days at the lowest temperature and a humidity of 80 per cent. The nymphs were thus less affected by dryness than the larvae. The relative

dispersion of length of life (the ratio of the time elapsing between the deaths of 25 and 75 per cent. of the population to the age reached by 50 per cent.) varied for larvae only from 0·14 to 0·56 and for nymphs from 0·16 to 0·5 under the various experimental conditions. Thus, environmental conditions lengthened or shortened the life of all individuals more or less uniformly.

EVANS (G. O.). **The seasonal Incidence of *Ixodes ricinus* (L.) on Cattle in Mid-Wales.**—*Bull. ent. Res.* **41** pt. 3 pp. 459–468, 7 figs., 11 refs. London, 1951.

The following is virtually the author's summary. An investigation of the seasonal incidence of *Ixodes ricinus* (L.) on cattle in north-western Cardiganshire showed that there are normally two peaks of activity, one occurring in spring and the other in autumn [*cf. R.A.E.*, B **37** 56 ; **39** 44]. The infestation curve varied considerably from farm to farm according to the husbandry methods practised. Delayed stocking of infested pastures caused an initial higher infestation of the cattle but, except on one farm, did not prolong the infestation beyond the normal period of tick activity. A lower infestation in spring than in autumn occurred on two farms. This resulted from either the lighter stocking of the infested grazings in spring than in autumn or the partial exhaustion of the unfed tick population by sheep grazing with the cattle during the spring only. There was no evidence for the occurrence of a unimodal curve of tick activity in the region studied.

EVANS (G. O.). **The Distribution and economic Importance of *Ixodes ricinus* (L.) in Wales and the Welsh Border Counties with special Reference to N.W. Cardiganshire.**—*Bull. ent. Res.* **41** pt. 3 pp. 469–485, 4 maps, 15 refs. London, 1951.

In the course of an investigation of 214 tick-infested farms in five counties in west Wales, *Ixodes ricinus* (L.) was found on all the farms and *Dermacentor marginatus* (Sulz.) (*reticulatus* auct.) on two neighbouring farms in northern Cardiganshire. Both occurred on cattle and sheep. The following is substantially the author's summary of observations made on *I. ricinus* in 1947 and 1948. The tick is widely distributed in the four chief grassland zones of north-western Cardiganshire. The most extensive areas of infestation are on the marginal and hill farms. In lowland areas, except on extensive stretches of marshland, infested pastures are confined to isolated tracts of badly managed or poorly drained land. Infested grazings are invariably "rough" and contain as the dominant plant either *Festuca* spp., *Agrostis* spp., *Molinia caerulea*, *Nardus stricta*, *Pteris aquilina* or *Juncus* spp. The degree of infestation of cattle depends on the relative area of the available grazing-land colonised by the tick. Continuous stocking of infested pastures results in heavy infestations.

The major tick-borne disease in north-western Cardiganshire is bovine piroplasmosis, caused by *Piroplasma* (*Babesia*) *bovis* [*R.A.E.*, B **28** 53], which predominates in the lowland districts. Outbreaks of the disease on marginal and hill farms are generally infrequent, since non-immune cattle are less often introduced. Tick pyaemia [**28** 52–53] is confined to lambs on hill grazings, and its incidence is low.

The distribution of *I. ricinus* in Wales and the border counties of Hereford and Shropshire shows a general relationship to areas of rough grazing. The tick is widespread in the western counties and is almost absent in the border counties. Radnorshire and Breconshire are interesting in that they have few infested farms in relation to the extensive nature of the "rough" grazing.

The results are also given of a survey of the incidence of bovine piroplasmosis in Wales.

THOMSON (R. C. M.). **Studies on salt-water and fresh-water *Anopheles gambiae* on the East African Coast.**—*Bull. ent. Res.* **41** pt. 3 pp. 487–502, 1 pl., 2 figs., 14 refs. London, 1951.

The relationship between *Anopheles gambiae* Giles and the closely related brackish-water breeder in West Africa, *A. melas* Theo., has now been clarified [*R.A.E.*, B **36** 97, etc.], but the situation in East Africa is still obscure. The occurrence of *A. gambiae* breeding in brackish water in East Africa has been recorded from time to time, and the name "*A. gambiae* var. *melas*" has been used for forms occurring there [**27** 90]. On the other hand, breeding of *A. gambiae* in salt water has long been recognised in Mauritius [**24** 311 ; **35** 151], though no adults of "var. *melas*" have been reported [**35** 150].

The results of investigations carried out at Dar-es-Salaam, Tanganyika, in 1947–48 with a view to clarifying the position of *A. gambiae* breeding in salt water there are given in this paper. The following is based on the author's summary. The brackish-water form of *A. gambiae* on the East African coast (and probably in Mauritius) is not the same as *A. melas* of West Africa. It resembled the latter in that a variable proportion of the females had a fourth dark band on the palps, whereas the rest were indistinguishable from typical *gambiae*, but differed in that the eggs and larvae showed no morphological differences from those of fresh-water *gambiae*. Larvae of the two East African forms differed clearly, however, in reaction to sudden changes in salinity, and a simple test was worked out whereby wild-caught females could be accurately identified by the reactions of their progeny. The females are isolated for oviposition in small cages containing a bowl of water with a few blades of grass. The eggs are put in a beaker of water, and the young larvae on hatching are immediately transferred to 75 per cent. sea water (a solution of 23·8 gm. sodium chloride per litre). Young larvae of fresh-water *gambiae* from inland areas all die within two hours, whereas those of salt-water *gambiae* survive for at least six hours. This test has formed the basis of all the author's work on the comparative incidence, habits and infectivity of *gambiae* from salt and fresh water in and near Dar-es-Salaam.

Exposed to equal chances of malaria infection in the same village during 1947 and 1948, fresh-water and salt-water *gambiae* taken in nature had sporozoite rates of 9·4 and 0·8 per cent., respectively. About 4 per cent. of both forms were infected with filaria larvae, but monthly figures showed that infection rates in salt-water *gambiae* may rise to 22 per cent. Fresh-water *gambiae* showed little tendency to leave African houses at dawn after feeding, whereas over one-third of freshly blood-fed females of salt-water *gambiae* left the house at dawn. Many half-gravid females of fresh-water *gambiae* left the shelter of the house at dusk on the night after the blood feed. There is no marked difference in sporozoite rate between those that left the hut and those that remained indoors at this stage. Blood-fed and gravid females of fresh-water *gambiae*, *A. funestus* Giles and salt-water *gambiae* were found in outdoor resting places, gravid females predominating in the case of the first two.

Although larvae of salt-water *gambiae* can complete their development in pure sea water [*cf.* **24** 311], increasing salinity becomes a limiting factor in nature before it reaches that of sea water, continuous breeding being no longer possible at salinities over 83 per cent. sea water. Salinity as a limiting factor explains the rather restricted breeding of salt-water *gambiae* on the coast, and suggests that certain coastal fresh-water swamps at Dar-es-Salaam could be cleared of all Anopheline breeding by a suitable arrangement of tidal gates permitting the circulation of sea water.

STONES (L. C.). **A comparative Method for testing Agents used in Sheep Maggot Fly Control.**—*Bull. ent. Res.* **41** pt. 3 pp. 503–521, 2 figs., 10 refs. London, 1951.

The difficulty of evaluating dips or sprays used to protect sheep against blowflies is discussed, and accounts of the construction and use of a " Fly-Sheep Chamber " for this purpose are given, with three series of results obtained when commonly used agents were tested in it against *Lucilia sericata* (Mg.), the principal sheep blow-fly in Britain. As the techniques are not intended to reproduce natural conditions, no attempt is made to estimate the duration of protection. Only relative values as compared with another agent are assessed. The test chamber described was an octagonal well-house, 23 ft. in diameter between opposite sides, with a slate roof, adapted by filling in the open sides with a double layer of a transparent material and fitting a plaster-board ceiling and cement floor with drainage. Suitable ventilation was provided. A wire pen was built inside leaving a space, 3 ft. wide, around it in which a green crop was grown. Heating during winter was provided by a hot-water system and light by four 40-watt " daylight " fluorescent tubes. To determine the effectiveness of treatments against ovipositing flies, sheep are exposed in the chamber to an active and dense fly population, maintained in controlled temperature and light. The method of rearing the flies is described. As an attractant, a fluid obtained by allowing maggots to feed on ox liver until it was considerably disintegrated, passing the mass through a sieve and diluting the liquor with glucose saline, was applied to test and control sheep twice daily on the days when they were in the chamber. This did not lose its potency when used in it, as other attractants did.

Groups of 5–6 sheep are treated with each of the agents under test on the same day, and from that time dealt with as one flock. They graze out-of-doors except for 48 hours each week, which they spend in the chamber exposed to the flies. About half the egg batches on control sheep developed into strikes (myiasis) in the chamber in summer. A separate test of larvicidal value was therefore necessary, and a modification of a technique devised by MacLeod [*R.A.E.*, B **26** 25] was adopted. The skin at the chosen site is moistened, lightly scratched and covered with a plug of damp cotton-wool 3 ins. long and half an inch wide, over which the fleece is closed. A cluster of 300–400 newly hatched larvae is placed directly above the plug about half an inch from the tip of the fleece and the tips are secured over the larvae with transparent adhesive tape. With this technique, strikes developed in 75–90 per cent. of cases on untreated sheep and the larvae are in the natural hatching position and have to pass the treated wool barrier to reach the skin. By using the two methods combined, comparative values can be assigned to the agents whether they act against the larvae or the adults. Larvicidal power is tested only after effective anti-adult activity has ceased. Protection was deemed to have ceased when about half the sheep showed eggs or established strikes.

In tests to illustrate the working of the technique, a dip containing 0·5 per cent. DDT (80 per cent. p,p′) in water suspension gave the most satisfactory protection, and achieved this purely by its action against the adult fly [*cf.* **35** 104]. A dip of 0·5 per cent. DDT in emulsified benzene was less satisfactory, as also was spraying as a method of application. In general, spraying with the suspension gave about half the protection afforded by dipping, and on sheep in full fleece, the application of 2 quarts spray was found to be inadequate. Protection was also found to be poor when the fleece was carefully dressed with 8 oz. dry powder containing 5 per cent. DDT.

Comparison was made between 0·5 per cent. DDT and 0·125 per cent. BHC (benzene hexachloride) containing 13–15 per cent. γ isomer as water suspensions and a proprietary arsenic-sulphur preparation (0·2 per cent. As_2O_3), all

used as dips. BHC and arsenic were shown to possess virtually no "anti-adult" properties as used. Both were efficient larvicides and provided a valuable and similar degree of protection against *L. sericata* at the concentrations tested, which are those at which they are applied for the control of sheep scab [*Psoroptes ovis* (Hering)]. Their effect was not quite so lasting as that of the DDT.

BURTT (E.) & JACKSON (C. H. N.). **Illustrations of Tsetse Larvae.**—*Bull. ent. Res.* **41** pt. 3 pp. 523–527, 12 figs., 4 refs. London, 1951.

Illustrations of the egg and three larval instars of *Glossina swynnertoni* Aust. are given, together with supplementary descriptive notes. The eggs and first- and second-instar larvae were dissected from flies taken in nature in Tanganyika. The third-instar larvae were obtained by keeping females in captivity until larviposition occurred.

ARTHUR (D. R.). **Acaricidal Control of the Tick,** *Ixodes ricinus* **(L.) on Cattle.** —*Bull. ent. Res.* **41** pt. 3 pp. 555–562, 4 graphs, 18 refs. London, 1951.

The results are given of trials of contact acaricides made in South Wales against *Ixodes ricinus* (L.) on dairy cattle. Washes were applied with a sponge, and the cattle were examined for attached females one, two and three days after treatment, and subsequently at intervals of three days for 18–30 days. Arsenic was omitted from the tests because of danger of poisoning stock or operators or contaminating milk, and coal-tar creosotes were omitted because their effect is transitory [*R.A.E.*, B **37** 83–84] and they might taint milk. The agents used were derris powder (5·5 per cent. rotenone) at 1 lb. with 4 oz. soft soap and 1 gal. water, a pyrethrum powder containing 0·9 per cent. pyrethrins I and II used as a saponified aqueous wash, DDT used at 0·5 per cent. in a wash with soft soap as a wetting agent and a dust of 5 per cent. DDT, 7·5 per cent. pyrethrum and 87·5 per cent. talc or kaolin. Talc was not a good carrier. The derris apparently killed all attached ticks within 48 hours and gave the most lasting protection from reinfestation. Engorging ticks first appeared in the axillae on the eighth day and elsewhere on the twelfth, but many were stupefied or shrivelled. The DDT wash became effective within 24 hours, and treated cattle remained free of ticks for three days in 21 cases out of 25. The pyrethrum wash gave a satisfactory kill of attached ticks, but its effect was of short duration. The DDT-pyrethrum dust did not give a satisfactory initial kill or have any lasting effectiveness.

LEWIS (D. J.) & KIRK (R.). **The Sandflies (Phlebotominae) of the Anglo-Egyptian Sudan.**—*Bull. ent. Res.* **41** pt. 3 pp. 563–575, 17 figs., 19 refs. London, 1951.

A list is given of 44 species and varieties of *Phlebotomus* from the Anglo-Egyptian Sudan, showing locality records for those not included in the authors' earlier papers [*R.A.E.*, B **28** 201; **38** 218] and additional records for some of the others; all records are shown diagramatically on maps. General notes on distribution are also included. The districts in which sandflies are most abundant are determined by the conditions that produce deep cracks in the soil [**38** 218]. Bats also use the cracks extensively, and bats' blood has been found in sandflies elsewhere [**31** 164]. In the Gezira irrigated area, *P. papatasi* Scop., which is presumed to be the vector of sandfly fever, though the latter occurs in occasional epidemics not necessarily associated with its abundance, is said to become troublesome each year when the cotton stalks are pulled up. This is about six weeks after irrigation ceases and not long after the beginning

of the hot season, and the sandflies have probably had time to breed in the cracks that form in the drying soil as well as in cracks in fallow ground.

Control of the immature stages depends on filling the soil fissures, which is often done automatically in the course of irrigation of gardens, or by seasonal rains or by trampling. DDT applied for the treatment of houses is effective against the adults. It was found to be impossible to keep *P. papatasi* and *P. clydei* Sinton alive in captivity for more than a few days in an area where DDT was being used, presumably owing to particles being blown about with dust, though they could be kept without trouble under similar atmospheric conditions three miles away. Dimethyl phthalate gave personal protection for several hours.

WHITNALL (A. B. M.), MCHARDY (W. M.), WHITEHEAD (G. B.) & MEERHOLZ (F.). **Some Observations on the Control of the Bont Tick,** *Amblyomma hebraeum* **Koch.**—*Bull. ent. Res.* **41** pt. 3 pp. 577–591, 2 pls., 5 figs., 9 refs. London, 1951.

An account is given of experiments carried out in South Africa in 1948 and 1949 on the control of *Amblyomma hebraeum* Koch on cattle by weekly treatment with dips or sprays. The materials tested were BHC (benzene hexachloride), arsenic, a combination of the two and, as a spray, a combination of BHC and DDT. *A. hebraeum* is a three-host tick, and control is directed chiefly against the adults, though the larvae and nymphs attach to cattle to some extent. BHC was used as a suspension of dispersible powder or paste or as an emulsified solution, and, after each dipping in it, samples of fluid were taken for chemical analysis. They were analysed for total hydrolysable chlorine and the γ isomer content estimated on the basis that crude BHC contained 10 per cent. of it [*cf. R.A.E.*, B **37** 209]. Biological tests of dipping and spraying fluid were also made by an *in vitro* technique [**36** 21].

The following is based on the authors' summary of the results. In the preliminary experiments, all treatments markedly reduced the numbers of male ticks on the cattle. Arsenic alone as a dip or spray and a dip of arsenic and BHC (50 parts γ isomer per million) did not reduce the numbers of females, and 50 p.p.m. γ BHC alone as a dip did so only slightly. Spraying with 50 p.p.m. γ BHC, however, was encouraging, and dipping in 100 p.p.m. was also satisfactory. The relative ineffectiveness of dipping was attributable to loss of activity of BHC in the dipping tanks through pollution. This makes chemical determination of dips based on total hydrolysable chlorine of little value unless it is correlated with a biological test.

The results of the preliminary experiments were largely confirmed by those of the second series. Males always outnumbered females in collections where the ticks were removed from cattle weekly. On untreated cattle on which infestations were allowed to accumulate, males increased week by week and eventually greatly outnumbered females. This suggests that males remained on the hosts longer, and were recorded more than once in the consecutive counts.

The arsenic spray did not reduce numbers of females or prevent them from engorging, but few females removed from treated cattle oviposited and those that did so laid sterile eggs, whereas females in a similar state of engorgement removed from untreated animals laid fertile eggs. All BHC treatments appeared more effective than arsenic, spraying again being more effective than dipping. The addition of 0·03 per cent. copper sulphate in a BHC dip did not prevent the loss of biological activity. When the BHC was in an emulsion concentrate, the dips were kept at the desired concentration and biologically active by adding fresh dip each week. Under these conditions, both dips and sprays were satisfactory when used at 100 p.p.m. γ isomer. Less was not adequate and a combination of 50 p.p.m. γ isomer and arsenic

used as a dip was not satisfactory and little better than the 50 p.p.m. γ BHC alone as a spray. Sprays made from a dispersible powder diluted to contain 50 p.p.m. γ BHC and 0·1 per cent. p,p'DDT gave striking results, reducing the weekly counts of ticks to below the number removed each week from an untreated control group and very much below those on cattle on which the ticks were allowed to accumulate. This might be due to persistent action or repellent effect.

HADAWAY (A. B.) & BARLOW (F.). **Studies on aqueous Suspensions of Insecticides.** —*Bull. ent. Res.* **41** pt. 3 pp. 603–622, 1 pl., 18 refs. London, 1951.

Since wettable powders showed promise for application in sprays to the mud walls of native houses to give deposits toxic to mosquitos [*R.A.E.*, B **38** 22], their properties were investigated in the laboratory with special reference to the relation between particle size and efficiency. Adults of *Aëdes aegypti* (L.) were exposed for short periods to deposits from aqueous suspensions of DDT, DDD (2,2-bis (p-chlorophenyl) 1,1-dichloroethane), methoxy-DDT (2,2-bis(p-methoxyphenyl) 1,1,1-trichloroethane), dieldrin (1,2,3,4,10,10-hexachloro-6-7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene) and γ BHC (benzene hexachloride) on blocks of plaster of paris, which was more suitable than mud for general tests of insecticides. The following is virtually the authors' summary of the results. There is an inverse relation between the size of ground DDT crystals fractionated into size ranges by sedimentation and their effectiveness. Smaller particles are more effective than larger ones, even when equivalent numbers are compared. Differences in effectiveness are attributed to differences in the amounts of insecticide picked up and retained by the insect. There is no significant increase in kills of mosquitos exposed for the same contact period to dosages of 10–20μ DDT crystals above 3 mg. per sq. ft. Persistence of deposits of these crystals, however, increases as the dosage increases. Crystal length alone is not critical, for fine 60μ DDT needles are slightly more effective than ground crystals in the 10–20μ range. The shape and mass of crystals together influence pick-up and determine their effectiveness. There is also an inverse relation between crystal size and effectiveness of methoxy-DDT and DDD. The effectiveness of dieldrin and of γ BHC is influenced much less by particle size than is that of DDT. The inert ingredient of a wettable powder has a masking effect on the insecticide, and this is intensified as the proportion of diluent to insecticide increases. The availability of the deposit from an aqueous suspension of DDT crystals depends largely on the nature of the surface to which it is applied.

PUJATTI (D.). **Il *Gryllodes sigillatus* W. èospite intermedio della *Hymenolepis nana*, Siebold 1852.** [*G. sigillatus* is an intermediate Host of *H. nana*.]—*Ann. Mus. Stor. nat. Genova* **63** pp. 235–241, 1 fig., 24 refs. Genoa, 1948.

While working in a prisoner-of-war hospital near Bangalore, South India, in 1941, the author found cysticercoids of *Hymenolepis nana* in the coelomic cavity of several examples of *Gryllodes sigillatus* (Wlk.) taken in the kitchen. Of a further 200 of these Gryllids examined subsequently, 58 harboured cysticercoids, up to 42 being found per individual. Eleven young rats were fed for three days on a diet including crushed Gryllids and cysticercoids from others, and eggs of *H. nana* appeared in the excreta of three of them after 13 days. One of the three was dissected, and strobilae were found in the intestine. All the forms observed are described. It is thought that the tapeworm could not have been var. *fraterna*, since it was not found in small rodents caught in and near the kitchen, and that the infestation of the Gryllids originated from the cook, who slept in the kitchen and was a carrier of *H. nana*. Gryllids were found among his bed-clothes and left-off clothing during the day. With their continuous capture, the infestation in them gradually died out.

Toop (C. R.). **The Sheep Itch Mite** (*Psorergates ovis*).—*J. Dep. Agric. W. Aust.* (2) **25** no. 4 pp. 343–347, 5 figs. Perth, W.A., 1948.

Psorergates ovis Womersley has been found on sheep in all the States of Australia [*cf. R.A.E.*, B **30** 140 ; **31** 249 ; **32** 125, 177], having been recorded in Western Australia in 1948. In view of its presence there, where its occurrence had been suspected for some time, notes are given on the signs of infestation [**30** 140], rate of spread [**31** 249], method of diagnosis and control with lime-sulphur dips [**32** 177, etc.].

Leclercq (M.). **Les myiases.**—*Rev. méd. Liège* **3** no. 6 pp. 133–140, 6 figs., 27 refs. Liège, 1948. **Premier cas d'ophtalmomyiase à** *Hypoderma* **en Belgique.**—*Op. cit.* **4** no. 11 pp. 296–301, 4 figs., 25 refs. 1949.

Chagnon (G.) & Leclercq (M.). **Myiase intestinale à** *Eristalis tenax* **L. (Diptère Syrphide).**—*T. c.* no. 21 pp. 634–635, 1 fig., 4 refs.

Leclercq (M.). **Premier cas de myiase des voies urinaires par** *Calliphora*.—*T. c.* no. 23 pp. 690–691, 1 fig., 8 refs.

In the first of these papers, the various types of myiasis in man are reviewed, with brief notes on treatment, and it is pointed out that flies that may cause some of them are quite common in Belgium. Certain cases of myiasis in Belgium are described from the literature.

In the second paper, the first case of ophthalmomyiasis in man to be recorded in Belgium is noted. It was caused by a first-instar larva of a species of *Hypoderma*. The life-cycle of *Hypoderma* in cattle is described, and notes are given on the ways in which it may infest man. Several types of ophthalmomyiasis are distinguished, and a list is given of flies that have been observed to infect the eye of man, those known to occur in Belgium being indicated. This is followed by a table of cases of ophthalmomyiasis caused by *Hypoderma*, showing the authorities and countries of the records.

A case of intestinal myiasis in Canada caused by *Eristalis tenax* (L.) is recorded in the third paper. A case of intestinal myiasis caused by *Eristalis* was recorded in Belgium in 1944 [*R.A.E.*, B **35** 154] and another in 1948.

The fourth paper consists of an account of a case of urinary myiasis in a man in Belgium caused by a species of *Calliphora* (probably *erythrocephala* (Mg.)).

Papers noticed by Title only.

Wigglesworth (V. B.). **The Principles of Insect Physiology.**—4th edn., revd., 10×6¼ ins., viii+544 pp., 355 figs., many refs. London, Methuen & Co. Ltd. ; New York, E. P. Dutton & Co. Inc., 1950. Price 42*s.* [*Cf. R.A.E.*, B **27** 169.]

Malone (R. H.). **Transmission of Kala-azar in India. The Case against the Sandfly** [*Phlebotomus argentipes* Ann. & Brun.]. **A Rejoinder.**—*Indian med. Gaz.* **82** no. 9 pp. 544–554, 28 refs. Calcutta, 1947. [*Cf. R.A.E.*, B **33** 153 ; **37** 21.]

Miller (D.). **Catalogue of the Diptera of the New Zealand Sub-region** [including list of animal hosts].—*Bull. Dep. sci. industr. Res. N.Z.* no. 100, 194 pp., frontis., 1 map. [Wellington, N.Z.] 1950. Price 13*s.* 6*d.*

Satchell (G. H.). **The Larvae of the British Species of** *Psychoda* **(Diptera : Psychodidae).**—*Parasitology* **38** no. 1–2 pp. 51–69, 84 figs., 30 refs. London, 1947.

Webb (J. E.). **The Structure of the Cuticle in** *Eomenacanthus stramineus* **(Nitzsch), (Mallophaga).**—*Parasitology* **38** no. 1–2 pp. 70–71, 1 pl., 2 refs. London, 1947. [See *R.A.E.*, A **39** 84.]

Jolly (G. M.). **The Use of Probits in combining Percentage Kills.**—*Ann. appl. Biol.* **37** no. 4 pp. 597–606, 1 fig., 6 refs. London, 1950. [See *R.A.E.*, A **39** 79.]

FAIRCHILD (G. B.) & HERTIG (M.). **Notes on the *Phlebotomus* of Panama (Diptera, Psychodidae). III.** *P. cruciatus* **Coq., *trinidadensis* Newst. and *gomezi* Nitz.**—*Ann. ent. Soc. Amer.* **41** no. 2 pp. 247–257, 13 figs., 9 refs. Columbus, Ohio, 1948.

In this third paper of a series on the *Phlebotomus* of Panama [*cf. R.A.E.*, B **38** 137], *P. cruciatus* Coq., which does not occur there, is included for comparison with *P. trinidadensis* Newst. and *P. gomezi* Nitzu. The characters of the three species are discussed on the basis of an examination of the type material of *P. cruciatus* from Guatemala and of specimens from Mexico and Guatemala believed to be conspecific with it, examination of *P. trinidadensis* from Panama and Venezuela and a comparison by P. Freeman of material from Panama with Newstead's types, and examination of over 350 Panama specimens of *P. gomezi*. The measurements of both sexes of the two Panama species, the female of *P. cruciatus* and the types of the last-named are tabulated.

The original description of *P. cruciatus* is wholly inadequate, so that some have considered it as unrecognisable and others as the species subsequently described as *P. trinidadensis* [**20** 161 ; **22** 49 ; **25** 42]. The type specimens included some taken biting in the jungle in the daytime and others resting on the outside walls of a house at night.

P. gomezi (of which *P. japignyi* Floch & Abonnenc from French Guiana and provisionally *P. suis* Rozeboom [**28** 218 ; **36** 141] are considered synonyms) may eventually prove to be a race of *P. cruciatus*, but as it is distinguishable from the latter and separated geographically by an extensive area from which no material is available, it is retained as a separate species. Examples taken biting in Trinidad proved to be *P. gomezi*, and specimens of this species were also seen from several localities in Costa Rica. *P. gomezi* and *P. panamensis* Shann. are the two common man-biting species in Panama, where they are about equally abundant. The type of *P. gomezi* was taken in a lighted room in Venezuela but no published evidence that it bites man in Venezuela, French Guiana or Brazil has been found. *P. diabolicus* Hall, a man-biting species from Texas [**24** 132], appears to be closely related to *P. cruciatus* and *P. gomezi* and may eventually prove to be a well-marked subspecies of the former.

Newstead's female types of *P. trinidadensis* are of doubtful identity, and the name must be based on the male. *P. baduelensis* Floch & Abonnenc, *P. villelai* Mangabeira and *P. yucatanensis* Galliard are considered conspecific with *P. trinidadensis* [*cf.* **37** 215] and a female from Colombia identified by Ristorcelli & Dao Van Ty as *P. longipalpis* Lutz & Neiva [**31** 11] is believed to belong to it. *P. trinidadensis* is now known from Brazil, Trinidad, French Guiana, Venezuela, Colombia, Panama and Mexico (Yucatan). It is one of the most abundant species in Panama, but has not been found to bite man or taken in any evident association with animals.

STONE (A.). **A Change of Name in Mosquitoes (Diptera, Culicidae).**—*Proc. ent. Soc. Wash.* **50** no. 6 p. 161. Washington, D.C., 1948.

The mosquito genus *Megarhinus* R.-D., 1827, is preoccupied by *Megarhinus* Rafinesque, 1820. *Toxorhynchites* Theo., 1901, appears to be the first available name for it.

MCCAULEY (R. H.), FAY (R. W.) & SIMMONS (S. W.). **The Importance of Coverage in DDT residual House Spraying for Control of *Anopheles quadrimaculatus* Mosquitoes.**—*Publ. Hlth Rep.* **63** no. 13 pp. 401–407, 1 fig., 3 refs. Washington, D.C., 1948.

The following conclusions are drawn from the results of experiments in Georgia in which adults of *Anopheles quadrimaculatus* Say were released in

rooms in which various amounts of surface had been sprayed with 5 per cent. DDT as an emulsified solution to leave a deposit of 200 mg. DDT per sq. ft. Satisfactory control of this mosquito cannot be expected from a spot treatment confined to the predictable resting places in a room (undersides of furniture and pictures, the parts of the wall immediately behind them and the corners of the room and the angles between the walls and ceilings). Complete treatment (coverage of the predictable resting places and the walls and ceilings) is more effective than the regular treatment (spraying only the walls and ceilings) ; the total area covered with DDT affects not only the initial knockdown efficiency of the treatment but the lasting effect as well. Complete treatment is experimentally more effective than regular treatment on the basis of knockdown in four hours. Efficient application is necessary for the maximum lasting effect to be obtained with DDT spray.

Leeson (H. S.), Lumsden (W. H. R.), Yofe (J.) & Macan (T. T.). ***Anopheles* and Malaria in the Near East.**—*Mem. Lond. Sch. Hyg. trop. Med.* no. 7, $9\frac{3}{4}\times7\frac{1}{4}$ ins., xii+223 pp., frontis., 73 figs., 1 fldg. table, 64 refs. London, H. K. Lewis & Co., Ltd., 1950. Price 35*s*.

This monograph is divided into three parts : " Anopheline Surveys in Syria and Lebanon 1941 to 1943 " by Leeson (pp. 1–46), " Anophelism and Malaria in Transjordan and in the neighbouring Parts of Palestine and Syria " by Lumsden & Yofe (pp. 47–108) and " The Anopheline Mosquitoes of Iraq and north Persia " by Macan (pp. 109–219).

In the first part, an introductory description of the country and its rivers, irrigation systems and climate is followed by an account of the methods used in Anopheline surveys made during the spring, summer and autumn from July 1941 to November 1943, and occasionally in the winter. Previous records of *Anopheles* from this area are reviewed, and notes are given on the prevalence, seasonal incidence and habits of the nine species found in the survey. The commonest and presumably the most important in transmission of malaria were *A. superpictus* Grassi, *A. maculipennis sacharovi* Favr and *A. claviger* (Mg.) [*cf. R.A.E.*, B **30** 152–153]. Out of 386 females of *A. superpictus* and 245 of *A. m. sacharovi* dissected, one and three, respectively, were found to have stomach infections. None had infected glands. *A. superpictus* was considered important chiefly because of its wide distribution and great abundance from May to October. *A. m. sacharovi* was important in certain areas because of its fondness for dwellings and its long flight-range. Descriptions are given of selected localities visited, followed in each case by notes on the species of *Anopheles* found and the dates of capture. The findings are summarised under five geographical headings.

The survey described in the second part was made in 1941 and 1942, and its main objects were to delimit areas in Transjordan and closely adjoining parts of Syria and Palestine where the risk of malaria was great and to gain enough knowledge of local conditions to advise effectively on military measures of control. The topography, geology, meteorology, hydrography, vegetation and population are dealt with fairly fully, and previous information on malaria is summarised and discussed. The incidence varies greatly from year to year, years of high transmission following winters of copious and late rainfall. Larvae of all the 11 species of *Anopheles* known to occur in Transjordan were taken in the 406 breeding places visited. Notes are given on their prevalence, local and seasonal distribution and preferred types of breeding places. Larvae of *A. superpictus* and *A. sergenti* (Theo.) formed 83·8 per cent. of the total identified and were most abundant before and after the end of September, respectively. They occurred in similar breeding places, almost wherever there was surface water, but the former favoured more sunlit and the latter partly

shaded places. The 2,261 adults taken in a few collections from houses or stables belonged to six species, among which only *A. m. sacharovi*, *A. superpictus* and *A. sergenti* were found regularly. The first was limited to the north of the plateau and the ghor (part of the Jordan valley, below sea level). Adults of three other species were occasionally taken out of doors. The results of spleen and parasite examinations at 34 localities representative of the different types of country in Transjordan are given and discussed. Malaria was found to be hyperendemic on the plateau near the marshes and in the ghor, and of low or moderate endemicity elsewhere. The prospects of Anopheline control are briefly discussed. Notes on the localities visited and Anophelines found in them are given in an appendix.

The third part opens with a general account of the area under consideration (the whole of Iraq, except the extreme western desert, and parts of Persia adjoining Iraq) and a detailed description of the five physiographical regions distinguished. The area was surveyed in 1942–43, for military purposes. Previous work on mosquitos in Iraq and Persia is very briefly reviewed, accounts are given of the scope of the survey and methods of collection, and observations made near the Hindiya barrage, an area typical of much of the alluvial plain region, in May and June 1943 are described at length. A list is given of the 16 species collected throughout the survey, with detailed notes on the distribution, seasonal occurrence, habits and relation to malaria of those that were taken in sufficient abundance. Of the vectors of malaria, *A. stephensi* List. was nearly always associated with high spleen rates and was the vector in the alluvial plain region [*cf.* **9** 159]. *A. m. sacharovi* was an additional vector in the date-palm gardens along the Shatt-al-Arab and the chief vector in the foothill and escarpment regions [*cf.* **34** 201–202]. *A. superpictus* also carried the disease in the foothills and escarpments and the Persian plateau region [**33** 16] and another variety of *A. maculipennis* Mg., probably var. *typicus*, in the Persian plateau region.

DE MELLO (J. P.). **Some Aspects of Malaria in Kenya.**—*E. Afr. med. J.* **24** no. 3 pp. 112–126, 6 graphs (1 fldg.), 1 map, 10 refs. Nairobi, 1947.

A severe epidemic of malaria occurred among Africans in Nairobi in 1940, and there had been others in 1930, 1934 and 1935. In all these years, rainfall was slightly above average. The seasonal distribution of cases in the epidemics is analysed. It is observed that in 1935 and 1940, the epidemics began with the onset of the rains (March) instead of six weeks later as they did in 1930 and 1934 and as would be expected, since the local vector, *Anopheles gambiae* Giles, thrives during and after the rainy season. There was a secondary peak at the expected time in 1940 but not in 1935, when the long rains failed. It is concluded that the cases in March and April are relapses due to a rise in humidity and that the relapse rate is the determining factor in the epidemics, which will develop in proportion to it, provided that the long rains do not fail and Anophelines are abundant.

VISWANATHAN (D. K.). **Malaria and its Control in Bombay State.**—$8\frac{1}{2} \times 5\frac{1}{2}$ ins., [2 +]2 + [2 +]2 + 263 pp., 3 pls., 16 graphs, 2 fldg. tables, 1 fldg. chart, 1 map. Poona, the Author [1950]. Price 15*s.* or $3.

This review of malaria and its control in Bombay includes a brief description of the State malaria organisation set up in 1942 to deal with the control of the disease first in Kanara District and eventually in the whole State ; accounts of the epidemiology of the disease in Kanara District and in Bombay State, its seasonal prevalence in various parts of the State, the behaviour of the main vector, *Anopheles fluviatilis* James [*cf. R.A.E.*, B **37** 31, etc.], and the control

effected with drugs, mosquito larvicides, clearing of streams and channels and space spraying against the adults [*cf.* **37** 32, etc.] before the introduction of DDT ; a report on the use of DDT as a spray to leave a toxic deposit indoors in the control of rural malaria ; an account of control in the urban area of greater Poona ; a survey of the Anophelines of the State, malaria surveys of various districts, and notes on plans for the future. These plans are based on the finding that treatment of houses with DDT reduces the densities of Anopheline vectors by nearly 90 per cent., and malaria morbidity and mortality by about 66 and 60 per cent. It is considered that three applications of DDT a year at a rate of 60 mg. per sq. ft. are required.

Savoor (S. R.), Das Menon (P.) & Merchant (S. M.). **Scrub Typhus (Tsutsugamushi Disease) in Bombay.**—*Indian med. Gaz.* **82** no. 12 pp. 752–756, 13 refs. Calcutta, 1947.

Eight cases of tsutsugamushi disease were found in Bombay City between June and December 1945. Three of the persons concerned resided in the suburb, but the other five were permanent residents of Bombay who had not been outside the city limits for at least four weeks. This was surprising as there were very few places in the city where Trombiculid mites were likely to be found. Notes are given on four of the five cases presumably acquired in the urban area. Three were in children who may have gone into thick vegetation on building sites or undeveloped land in the course of play, and the fourth in a cook who, it is suggested, may have become infested with Trombiculid larvae when handling vegetables.

Brown (J. H.) & Kohls (G. M.). **The Ticks of Alberta with special Reference to Distribution.**—*Canad. J. Res.* (D) **28** no. 3 pp. 197–205, 5 maps, 15 refs. Ottawa, 1950.

The records in this paper are the result of 11 years of collecting over the accessible parts of Alberta, with the exception of the settled area from Lac La Biche to Fort McMurray. The species recorded are *Dermacentor andersoni* Stiles, *D. albipictus* (Pack.), *Haemaphysalis chordeilis* (Pack.), *H. leporis-palustris* (Pack.), *Ixodes angustus* Neum., *I. kingi* Bishopp, *I. sculptus* Neum., *I. spinipalpis* Nutt., and *Otobius lagophilus* Cooley & Kohls. Maps showing the known distribution of the several species in Alberta are given. Some of the records in an earlier paper [*R.A.E.*, B **33** 74], including those of two species of *Ixodes*, are changed because of synonymy or previous misidentification. It appears that records of *Otobius* (*Ornithodoros*) *megnini* (Dugès) refer in fact to *Otobius lagophilus* ; and *H. chordeilis* is the North American bird tick that was formerly recorded as *H. cinnabarina* Koch [but is considered by Cooley (**38** 16) to be distinct from *H. cinnabarina*, which was described from Brazil].

Brennan (J. M.). **An Instance of the apparent Toxicity of Man to Ticks.**—*J. Parasit.* **33** (1947) no. 6 (Sect. 1) pp. 491–494. Lancaster, Pa. [1948].

Observations were made during the early autumn of 1946 on a man who is apparently toxic to ticks. *Dermacentor andersoni* Stiles and *Amblyomma americanum* (L.) were the species used in most of the tests. The man said that from early boyhood he had never been annoyed by ticks or Trombiculids and rarely bitten, though he was frequently exposed, and dead ticks had often been found in his clothing. When adults of *A. americanum* and adults and nymphs of *D. andersoni* were applied to his arms in ventilated feeding cells, they refused to remain on the skin and retreated to the most remote part of the cell. Ticks placed on the skin and not restrained crawled off as soon as possible. When ticks were forced to remain in contact with the skin, they

occasionally bit. Adults of *A. americanum* and *D. andersoni* confined on parts of the body where there was free perspiration were immobilised in every instance, and though they revived, they never became quite normal. Nymphs of *D. andersoni* in the same circumstances were usually killed in a few minutes. When the ticks were confined for 20–30 minutes on the skin of the upper arms or thighs where there was no free perspiration, results were less consistent, but there was some repellent effect and usually some toxic effect. Five adults of *Ornithodoros parkeri* Cooley, however, behaved normally during and after confinement on the thigh for an hour. Ticks were not affected when confined in rubber gloves that the man had worn or when confined close to, but not in contact with, his skin, and survived as long in his urine as in that of other people.

The man was of European race, scrupulously clean, in apparently good physical condition and exceptionally hairy. He smoked and drank alcohol only occasionally, but habitually drank very large quantities of coffee. He took no chemicals, medicines or narcotics. If the phenomenon is caused by the existence, presumably in his sweat, of a substance both toxic and repellent to ticks, its isolation might prove of far-reaching value.

Snuparek (J.). **Malaria in Czechoslovakia after World War II.**—*J. Parasit.* **33** (1947) no. 6 (Sect. 1) pp. 506–508, 6 refs. Lancaster, Pa. [1948.]

Malaria occurred in two parts of western Czechoslovakia in 1945 and 1946 after having been unknown there for nearly 100 years. In one of the areas, southern Moravia, Anophelines acquired the infection from the Russian army and in the other, north-western Bohemia, from labourers brought into the country from southern and eastern Europe. The parasite involved was *Plasmodium vivax*. The Anophelines found in Czechoslovakia are *Anopheles maculipennis* Mg. vars. *typicus* and *messeae* Flni. and *A. claviger* (Mg.) [*cf. R.A.E.*, B **30** 74]. No epidemic developed, possibly because of strict isolation and treatment of cases, but an increase in the number of new infections in 1946 showed that there was danger of the disease becoming more widespread.

Cutkomp (L. K.), Hess (A. D.) & Keener (G. G.). **Factors influencing Spray and thermal Aerosol Application by Airplane.**—*J. econ. Ent.* **43** no. 4 pp. 456–462, 4 figs., 10 refs. Menasha, Wis., 1950.

For some years, DDT has been applied from aircraft in thermal aerosols for the control of larvae of *Anopheles quadrimaculatus* Say in the impounded waters of the Tennessee Valley [*R.A.E.*, B **37** 97]. While this method has many advantages, low-level flying is necessary, and excessive drift may result from unfavourable stratification of the air. Tests to compare the effectiveness of the aerosols and of sprays applied with five ordinary nozzles directed backwards from different parts of the aeroplane indicated that aerosols cannot in general be effectively applied from a height much above 35 ft., whereas effective results can be obtained with sprays applied from 50 ft. The deposit and distribution obtained with the thermal aerosol were found to be influenced by the density (weight) of the spray liquid, as well as particle size. The deposit was greater with a denser liquid (1·12 as compared with 1·02 gm./ml.) and also in cool conditions (60° F. as compared with 70°). Both density and temperature had more pronounced effects on the small particles of the thermal aerosol than on the larger ones of the spray. The effect of temperature is related to the physical properties of the droplets. Sprays were found to contain

particles of widely differing sizes, including many small ones less than 30 μ in diameter. Thus, on the assumption that small particles penetrate vegetation more easily, the effect of dense vegetation in stopping spray particles may not be as great as has been thought.

DEONIER (C. C.), CAIN jr. (T. L.) & MCDUFFIE (W. C.). **Aerial Spray Tests on Adult Salt-marsh Mosquitoes resistant to DDT.**—*J. econ. Ent.* **43** no. 4 pp. 506–510, 1 ref. Menasha, Wis., 1950.

Observations in Florida in June 1949 indicated that the usual application of DDT sprays from aeroplanes was not controlling larvae or adults of the salt-marsh mosquitos, *Aëdes taeniorhynchus* (Wied.) and *A. sollicitans* (Wlk.), so well as formerly. This was particularly noticeable in an area where DDT had been applied on a small scale in 1943 and 1944 and extensively since 1945. It appeared that the mosquitos had developed some degree of resistance to DDT, and laboratory tests on larvae and adults from treated and untreated areas confirmed this. Field tests with sprays applied from aircraft were therefore carried out in the treated area to give information on the relative effectiveness against the adults of technical BHC (benzene hexachloride containing 12 per cent. γ isomer), lindane [containing at least 99 per cent. γ BHC], toxaphene, parathion, chlordan and dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] in oil solution and to determine whether any would be an effective substitute for DDT, which was used in oil solution or emulsified solution.

The following is based on the authors' summary of the results. DDT and chlordan gave variable results, and neither was highly effective in most tests at dosages of 0·2 and 0·3 lb. per acre. Chlordan at 0·6 lb. showed excellent results six hours after application, but the reduction effected after 24 hours was only 79–88 per cent. Lindane was the most effective material, and gave good control both of *A. sollicitans* in open areas and of *A. taeniorhynchus* in woods at 0·1 lb. per acre. Technical BHC at 0·2 and 0·4 lb. per acre gave results comparable with those given by lindane at 0·05 and 0·1 lb. per acre on the open marshes, but was less effective in the woods. The results with dieldrin at 0·1 and 0·05 lb. per acre were not quite so good as those with lindane. Parathion at 0·1 and 0·05 lb. gave good reduction of *A. sollicitans* but was less effective in the woods against *A. taeniorhynchus*. Toxaphene appeared less effective than DDT.

PIMENTEL (D.), SCHWARDT (H. H.) & NORTON (L. B.). **House Fly Control in Dairy Barns.**—*J. econ. Ent.* **43** no. 4 pp. 510–515, 10 refs. Menasha, Wis., 1950.

The following is mainly from the authors' summary. Experiments on the control of *Musca domestica* L. with organic insecticides in various concentrations and formulations were made in 154 dairy barns in New York in the summer of 1949. Six barns were treated with toxaphene at the rate of 0·24 lb. per 25-cow barn applied as an aerosol from a fog generator, but this gave control for only one day. The others were treated with sprays, and the quantities of insecticides given below are those per 100 U.S. gals. ; the deposit was about 15 mg. per sq. ft. for each lb. insecticide.

Control of the flies in barns that had been heavily infested before treatment was maintained for four weeks or more with 2 lb. lindane [at least 99 per cent. γ benzene hexachloride], 6, 12 or 24 lb. chlordan or 8 lb. toxaphene, all as emulsions, 16 lb. toxaphene as an emulsion applied by spot treatment, or a mixture of 3 lb. DDT as a wettable powder with 6 lb. chlordan as an emulsion. Treatments providing effective control for less than four weeks were 0·6, 2 or 4 lb.

lindane as a wettable powder, 4 lb. lindane as an emulsion by spot treatment, 8 lb. toxaphene as a wettable powder or as an emulsion by spot treatment, 12 lb. DDT as an emulsion, 30 lb. DDT or 20 or 30 lb. methoxy-DDT (methoxychlor) as a wettable powder, and mixtures of 5 lb. DDT as a wettable powder with 1 lb. lindane as an emulsion, or with 0·25 lb. lindane or 2·5 lb. methyl-DDT (ditolyl trichloroethane), both as wettable powders.

Emulsifiable formulations of lindane and toxaphene were significantly better than wettable powders. When the concentration of toxaphene was doubled with the spot treatment method, about the same amount of toxaphene was used as in the overall treatment of a barn, and the control period was at least equal to that of the overall treatment. DDT in concentrations as high as 30 lb. per 100 U.S. gals. water gave an average control period of only two weeks. Combinations of DDT with methoxy-DDT (tested in moderately infested barns), lindane or methyl-DDT were not significantly more lasting in effect than DDT alone. Methoxy-DDT alone was not better than when combined with DDT. Lindane alone at higher dosages gave longer periods of control, so probably the poorer control given by lindane mixed with DDT was due to lower concentrations of the former.

The amounts of DDT and lindane found in milk for four weeks after treatment were insignificant, except for the analyses made after 48 hours and one week of milk from barns treated with 12 lb. DDT and an occasional single sample with the lower concentrations of DDT. The elimination of flies from dairy barns did not cause any detectable decrease in the bacteria count of milk.

LUDVIK (G. F.). **Barrier Strip and pre-flood Treatments with DDT to control** *Anopheles quadrimaculatus*.—*J. econ. Ent.* **43** no. 4 pp. 516–519, 1 fig., 11 refs. Menasha, Wis., 1950.

Spraying a strip of vegetation to provide an insecticidal barrier against mosquitos may be designed to surround temporary concentrations of human populations or to isolate mosquito breeding areas. In the first instance, control to be effective must be essentially complete. In the second, mosquitos that cross the barrier have to recross it to oviposit so that the chance of their being killed is much greater, and the larval population would be expected to fall rapidly. Before barrier treatment is undertaken, the flight habits of the species concerned and the character of the vegetative screen should be considered.

In the studies described, a horseshoe-shaped barrier strip of dense marginal vegetation around a breeding area in northern Alabama was sprayed with emulsified solution of DDT in xylene to leave a deposit of about 280 mg. DDT per sq. ft. for the control of *Anopheles quadrimaculatus* Say. The height and width of the barrier were arbitrarily fixed at 10 and 50 ft., respectively, and the amount of DDT applied was 1,420 mg. per sq. ft. of ground covered. Of 5,000 dyed adults of *A. quadrimaculatus* released within the breeding area, only 0·12 per cent. were recovered at checking stations (hollow trees, nail kegs and portable privy-type structures) over a period of eight weeks following treatment. In previous studies, recoveries had varied from 0·06 to 20 per cent. with an average of about 7 per cent. The results are thought to suggest that the barrier was highly effective, though the recovery fell within the limits of recapture from an untreated area. Populations of larvae and adults were immediately reduced by the application. Undoubtedly, some of the spray drifted out over the water, killing numerous larvae.

An application of DDT in solution in Velsicol NR-70 at 1·4 lb. per acre to a flat, marshy area in the first week of April, before water levels were raised and oviposition began, appeared to retard the development of larvae for about

seven weeks and the build-up of the adult population for about eight weeks. Larvae introduced into the treated area were significantly affected for at least three weeks.

McDuffie (W. C.), Eddy (G. W.), Clark (J. C.) & Husman (C. N.). **Field Studies with Insecticides to control the Lone Star Tick in Texas.**—*J. econ. Ent.* **43** no. 4 pp. 520–527, 5 refs. Menasha, Wis., 1950.

The following is almost entirely based on the authors' summary. The effectiveness of several insecticides for the area control of *Amblyomma americanum* (L.) was investigated at Camp Bullis, Texas, during the seasons of 1946 and 1947 and at Kerrville, Texas, in 1948. They included two grades of BHC (benzene hexachloride), stated to contain 18 and 10 per cent. γ isomer, respectively, of which the first was used at Camp Bullis and the second at Kerrville.

When applied in sprays at Camp Bullis, DDT at 1 and 2 lb. per acre provided good control within 2–14 days and remained effective for 4–6 weeks or more. Chlordan and toxaphene at 1 and 2 lb. were about as effective as DDT at the same rates. BHC at 0·5 and 1 lb. immobilised ticks within a few hours but gave less effective control than the other insecticides. Sprays containing 0·5 and 1 per cent. nicotine sulphate applied at 50–100 U.S. gals. per acre caused immediate immobilisation of ticks, but the majority recovered within 24 hours. Lethane 380 (organic thiocyanates) and Thanite (mainly isobornyl thiocyanoacetate) at 2 per cent. in sprays applied at 50 U.S. gals. per acre were relatively ineffective both for knockdown and kill under the conditions tested. Effective control with sprays appeared to depend on thorough coverage and penetration of tick-infested ground litter, either by the use of large volumes of liquid applied as coarse sprays or of smaller quantities applied as fine-mist sprays from closer range. Drifted sprays proved unsatisfactory.

Aeroplane applications of DDT in oil solutions or in water emulsions at rates of 2·5–5 lb. per acre failed to give satisfactory control. BHC applied at 1·5 lb. per acre was also ineffective. It appeared that the aerial applications did not provide an adequate surface deposit or penetrate the ground litter sufficiently.

In tests of dusts at Camp Bullis, DDT at 2 and 4 lb. per acre gave good control of ticks in some tests, but the results were not consistent, and 1 lb. was ineffective. Chlordan and toxaphene at 1 and 2 lb. per acre appeared to be slightly more effective than DDT at the same rates. BHC immobilised ticks within a few hours, but only maximum applications of 4 lb. per acre provided satisfactory control for any length of time. Dusts containing both DDT and BHC were advantageous for immediate control, but the deposits were not effective for any longer than the individual chemicals at 4 lb. per acre. Dusts containing 2 per cent. nicotine and applied at 40 lb. per acre gave excellent immediate knockdown of ticks and good control for about two weeks. Lower concentrations were much less effective. Pyrethrum dusts containing 0·2 and 0·4 per cent. pyrethrins gave good knockdown of ticks within a few hours but only 66–86 per cent. control. The inclusion of 2·5 per cent. piperonyl cyclonene or piperonyl butoxide did not increase the effectiveness of the pyrethrum dusts.

In tests with dusts at Kerrville, Texas, in 1948, BHC gave about as long-lasting control at 1 and 2 lb. per acre as at 4 lb., and was as effective as chlordan or toxaphene, and at least as effective as DDT at each of the test dosages. The results with the different materials were somewhat better at Kerrville than at Camp Bullis, especially so with BHC. Parathion at 0·25–1 lb. per acre gave control at least equal to the other materials at 1–4 lb. per acre.

In a large-scale test on 240 acres at Camp Bullis in 1947, 43 lb. per acre of dust containing 10 per cent. DDT gave a 76 per cent. reduction of the tick

population within one week and 97 per cent. within six weeks. The area remained relatively free of ticks during the remainder of the season, and in April 1948, nine months after treatment, a control of 99 per cent. was indicated. By September 1948, 14 months after treatment, the area contained only 30 per cent. as many ticks as the check area. These results indicated that large treated areas may become reinfested much more slowly than small experimental plots of an acre or less.

KING (W. V.). **DDT-resistant House Flies and Mosquitoes.**—*J. econ. Ent.* **43** no. 4 pp. 527–532, 7 refs. Menasha, Wis., 1950.

The following is mainly based on the author's summary. Tests were carried out in dairy barns in two localities in Florida in 1949 to determine the relative effectiveness of different insecticides applied as treatments to leave a toxic residue against house-flies (*Musca domestica* L.) that had developed resistance to DDT. Chlordan in emulsion at 100 and 200 mg. toxicant per sq. ft. was the most consistently effective material, followed by dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] in emulsion at 50, 25 and 10 mg., lindane [containing at least 99 per cent. γ benzene hexachloride] as a wettable powder at 50 mg., toxaphene emulsion at 200 mg., and a wettable powder spray of DDT and methoxy-DDT (methoxychlor) at 100 mg. of each. Most of the tests with the DDT and methoxy-DDT alone were failures, as were two out of four with the mixture and all of four with pyrethrum extract [*cf. R.A.E.*, B **39** 7]. A few preliminary tests in which low dosages of the compounds were dispersed as space sprays in infested barns several times a week were promising. In tests in which 21 lots of flies from 18 different barns in the Orlando area were exposed to plywood panels treated with 25 mg. DDT per sq. ft., the exposure time required to produce 70 per cent. mortality of female flies (LT-70) ranged from about 4 to 17 times that of a normal laboratory colony. For nine lots tested with methoxy-DDT, the average LT-70 was slightly over twice as long as that for the laboratory colony, whereas for lindane, toxaphene and dieldrin, in smaller numbers of tests, the LT-70 was less than twice as long. Of 14 lots of flies received from different localities in the United States in 1948 and reared in the laboratory, all showed a great variation in susceptibility to DDT in consecutive generations, but most of them gave evidence of a definite loss of resistance after a few generations [*cf.* **39** 7]. A highly resistant laboratory colony [**38** 94] was much less resistant to several other insecticides. This colony showed a partial loss of resistance to DDT after nine generations without further exposure to the compound [*cf.* **38** 156, etc.].

Results of large-scale field tests on the effectiveness of various insecticides against *Aëdes taeniorhynchus* (Wied.) and *A. sollicitans* (Wlk.) in areas where these mosquitos had been found to have developed resistance to DDT have been noticed from a fuller account [**39** 58]. In laboratory tests with adults of *Anopheles pseudopunctipennis* Theo., from a Mexican village where all premises had been treated with DDT sprays to leave a toxic deposit once each year during the previous three years, there was no indication of increased resistance.

In an experiment carried out by G. H. Culpepper & C. N. Smith, *Pediculus humanus humanus* L. (*P. h. corporis* Deg.) did not show increased resistance to DDT after exposure of the third-instar nymphs of each generation for eight generations to concentrations of DDT powder that killed about 75 per cent. In another experiment, about 4,000 adults were exposed to a concentration that killed all except ten. The progeny of these were reared through six generations without further exposure to DDT, and at the end of this time there was no evidence of increased resistance.

DE ONG (E. R.), PEER (K. C.) & FANCHER (L. W.). **A new Generator for producing dry Aerosols with organic Insecticides.**—*J. econ. Ent.* **43** no. 4 pp. 542–546, 5 figs., 1 ref. Menasha, Wis., 1950.

The authors describe and figure an aerosol generator of the thermal decomposition type that operates at a much lower temperature than those in which pyrotechnic mixtures are employed [*cf. R.A.E.*, B **37** 226; **38** 27]. The aerosol produced is termed " dry " to distinguish it from mechanically produced aerosols in which the insecticides are in auxiliary solvents. The generator contains the insecticides in powdered admixture with unspecified dispersing chemicals, and a chemical reaction of the latter, initiated by means of a starter strip of the friction match type, first softens the insecticides by heat and then propels them into the air by the evolution of steam and other inert gases. The reaction proceeds throughout the mass in an even manner, the temperature seldom exceeds 250°C., and the large volumes of steam protect the organic insecticides from decomposition as they are dispelled. A zone of live steam and hot gases carrying the insecticides directly over the outlet is followed by one in which the steam condenses into fine droplets of water and insecticide about 5 μ in diameter. Most of the water has evaporated after 30 minutes at ordinary humidities, and the aerosol particles then begin to agglomerate and attain a size of 10–50 μ. Deposition of these on surfaces is followed by the growth of crystals, which may reach a length of 200 μ in the case of DDT. These project from the surface, allowing maximum contact with the insects. In the initial stage of suspension, the aerosol penetrates readily into microscopic openings, but after a few minutes will not penetrate fabrics of medium fine weave, owing to the increase in particle size. The insecticide deposit is even on all surfaces, but highest on horizontal ones. Insecticidal compounds such as DDT, chlordan, certain thiocyanates (including Lethane 384), methoxy-DDT (methoxychlor) and BHC (benzene hexachloride) can be dispersed by this method with negligible decomposition. Liquid insecticides can be dispersed in formulations containing about 10 per cent. by weight, about 15 per cent. solid organic compounds being also present if desired, and solid ones in formulations containing about 30 per cent. by weight. The employment of an aerosol generator of this type is restricted to confined spaces, but it has the advantages that a cardboard container can be used for it and it is easy to operate without continued attention.

An aerosol formulation containing 2 gm. DDT and 0·8 gm. Lethane 384 dispersed from the generator in a chamber of 1,000 cu. ft. capacity gave complete knockdown and kill of house-flies [*Musca domestica* L.] in wire cages 30 inches above floor level in 30 minutes and 8 hours, respectively. When half the amount of the same aerosol was dispersed in a 1,000 cu. ft. chamber and wire cages with backs and sides of unpainted wood were exposed to collect the deposit, house-flies that were introduced into the cages at temperatures of 60–68°F. and 55–64°F. suffered complete knockdown in four and three hours and complete mortality in five and 12; after six days, 78 per cent. knockdown occurred in nine hours at 60–68°F., but no mortality was reported.

Various insecticides dispersed from the generator against pests of stored grain in the laboratory and in infested railway waggons afforded space-kill and residual protection [*R.A.E.*, A **39** 118], and it is suggested that it might be used in some circumstances instead of fumigation with toxic gases. When rabbits and their food-supply were enclosed in a chamber and subjected to twice the recommended dosage of dry aerosol for ten days, no acute toxic effects were observed. Respiratory irritation occurred in two of the ten test animals on the eighth day, but disappeared on removal from the chamber. It is believed that the absence of auxiliary solvents contributes to lowered toxicity to warm-blooded animals. Laboratory workers exposed to numerous

aerosols of DDT, methoxy-DDT, BHC, chlordan and Lethane 384 over a period of five years exhibited no acute or chronic toxic symptoms.

Bodman (M. T.) & Gannon (N.). **Some Habitats of Eggs of *Aëdes vexans*.**—*J. econ. Ent.* **43** no. 4 pp. 547–548, 2 refs. Menasha, Wis., 1950.

Eggs of *Aëdes vexans* (Mg.) are laid in certain areas subject to flooding [*cf. R.A.E.*, B **36** 194]. In the autumn of 1949, observations were made in Illinois on the relative abundance of viable eggs in various habitats subject to inundation by rain or the overflow of streams and differing in shade, type of soil and degree of slope. As many as 32 eggs per 100 sq. in. were recovered from clay or clay loam soils, but no eggs were found in lighter types of soils. When the edge of a stream sloped up very steeply, eggs were found only in a very narrow band. Eggs were not found on vertical banks. A certain amount of shade was essential. The requirements that were revealed were all connected with conservation of moisture. Eggs were found in surface débris and in the soil, usually to a depth of one inch, but occasionally to a depth of 2 ins. They occurred in two bands in the bed of an almost dry woodland slough, one 5–10 ft. from the water's edge and one 35 ft. away. It is assumed that the two bands represent two periods of oviposition and that both lots of eggs were laid near the edge of the water.

Denning (D. G.) & Pfadt (R. E.). **Evaluation of certain Insecticides in Horn Fly Control.**—*J. econ. Ent.* **43** no. 4 pp. 557–558, 3 refs. Menasha, Wis., 1950.

During 1946–49, several insecticides were tested as sprays for the control of *Siphona irritans* (L.) on cattle in dairy or range herds in five localities in south-eastern Wyoming at levels between 4,100 and 7,500 ft., representative of most elevations in the State where the fly is a serious problem. The sprays were applied to the topline and underline at a pressure of about 150 lb. per sq. in. and at 1–2 U.S. pints per animal, and herds were resprayed when the average count reached 25–30 flies. The results are given in a table. All the insecticides tested, namely DDT, methoxy-DDT (methoxychlor), a mixture of DDT and benzene hexachloride, DDD (dichlorodiphenyl dichloroethane) and chlordan (all as wettable powders) and emulsion or wettable-powder combinations of pyrethrins and piperonyl butoxide protected cattle adequately.

It is concluded that 1 per cent. methoxy-DDT provides a safe and satisfactory spray for dairy herds, affording protection for an average of 22·5 days. A wettable-powder spray of 0·075 per cent. pyrethrins and 1 per cent. piperonyl butoxide is also safe and was effective for an average of 14·2 days. A spray containing 1·5 per cent. DDT would be satisfactory on range herds, its effect lasting for an average of 27·2 days. Under Wyoming conditions, it appears that 4–5 treatments with methoxy-DDT or DDT are needed to maintain adequate control for the season (late April to late October). An early application when few flies were present did not lessen the total number required.

Eddy (G. W.) & Graham (O. H.). **An improved Laboratory Method for testing Materials as Screw-worm Larvicides.**—*J. econ. Ent.* **43** no. 4 pp. 558–559, 2 refs. Menasha, Wis., 1950.

A modification of Bushland's method [*R.A.E.*, B **29** 83] of testing the toxicity of compounds to larvae of *Callitroga hominivorax* (Coq.) (*americana* (Cush. & Patt.)) was developed by the authors during 1947. It makes possible the testing of a greater number of materials in a given time and greatly reduces the amounts of insecticide and medium required for a given test. It is also

probably more accurate than Bushland's method. In general, materials appear more toxic by the new method than by the old. The ingredients in the culture medium are the same, but they are used in slightly different proportions. A 5 per cent. solution of the material to be tested in a mixture of acetone and a polyoxyalkylene derivative of sorbitan monolaurate (9 : 1) is prepared, 0·2 ml. of the solution is mixed with 6 ml. of the liquid ingredients of the medium, and 4 gm. ground meat is then added. The medium is stirred again and kept at 90°F. for about an hour before the larvae are put on it. The tests are made at 90°F. and 85 per cent. relative humidity. Materials that do not kill all of 25 larvae in 48 hours are not tested further. Those that do so are retested at lower concentrations until the minimum lethal concentration is determined. Newly hatched larvae tolerate up to 4 per cent. acetone without noticeable injury.

GUTHRIE (F. E.). **Effect of Temperature on Toxicity of certain organic Insecticides.**—*J. econ. Ent.* **43** no. 4 pp. 559–560, 11 refs. Menasha, Wis., 1950.

In tests of the effect of temperatures of 14·5, 22 and 32°C. [58·1, 71·6 and 89·6°F.] on the toxicity of five insecticides applied topically to *Blattella* (*Blatta*) *germanica* (L.), DDT, pyrethrum and lindane [at least 99 per cent. γ benzene hexachloride] were most toxic at the lowest temperature and least toxic at the highest, whereas the reverse was true for dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] and aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene]. The results obtained with the benzene hexachloride were quite variable, but the general trend was maintained throughout, and was the opposite of that observed by Hoffman, Roth & Lindquist [*R.A.E.*, B **38** 153–154].

GERSDORFF (W. A.) & MITLIN (N.). **Relative Toxicity to House Flies of Tetra-n-Propyl Dithionopyrophosphate.**—*J. econ. Ent.* **43** no. 4 p. 562, 1 ref. Menasha, Wis., 1950.

When tested in deobase oil by the turntable method [*R.A.E.*, B **26** 264] against adults of *Musca domestica* L., tetra-n-propyl dithionopyrophosphate was about three times as toxic as the standard pyrethrum extract at the level required to give 50 per cent. mortality, but only about one-twentieth as toxic as pure parathion [*cf.* **37** 190]. The relationships were not greatly different at other levels of kill. It has been claimed that tetra-n-propyl dithionopyrophosphate is non-toxic to white mice, and if it proves to be of low toxicity to man, further work with it as a potential insecticide would be desirable.

CARTER (R. H.), HUBANKS (P. E.), MANN (H. D.), ALEXANDER (L. M.) & SCHOPMEYER (G. E.). **Effect of Cooking on the DDT Content of Beef.**—*Science* **107** no. 2779 p. 347, 4 refs., repr. 3 pp. Lancaster, Pa., 1948.

One of a herd of cattle that had received DDT in clover hay from 5th January to 1st April was slaughtered on 10th May, and the carcass was kept in cold storage until December. Beef from it was then cooked by five methods or left uncooked and tested for DDT content. Chemical analysis indicated that the DDT in the beef was not materially decomposed or lost during roasting, broiling, pressure cooking, braising or frying.

MACKERRAS (M. J.) & ROBERTS (F. H. S.). **Experimental malarial Infections in Australasian Anophelines.**—*Ann. trop. Med. Parasit.* **41** no. 3–4 pp. 329–356, 9 graphs, 21 refs. Liverpool, 1947.

The methods used in collecting and rearing Australasian Anophelines in Queensland [*cf. R.A.E.*, B **37** 173] for the experimental transmission of Melanesian strains of malaria are described, and incidental observations are recorded on their behaviour in captivity and susceptibility to infection. Over 233,000 mosquitos were handled, and more than 20,000 infected bites were inflicted. Newly emerged females fed readily on carbohydrate food, which was always available until within six hours of a blood-meal being offered. They were usually kept for 48 hours before being offered a blood-meal, as few would bite on the first day. If necessary, moist heat or, in very hot weather, iced towels, were applied to the cages to induce engorgement. Engorged females were transferred to "standard cages" measuring $15 \times 8 \times 9$ ins. and covered with damp towels. They were provided with slices of fresh apple. For the experimental transmission of infection, volunteers pressed the back of the hand against the netting of the cage. If only one or two infections were needed, the mosquitos were handled singly in tubes and dissected as soon as they had completed feeding. Dissection technique is described.

Anopheles punctulatus Dön., which was imported from Milne Bay, New Guinea, or bred from imported stock, was more avid for human blood than any of the Queensland mosquitos studied (*A. farauti* Lav., *A. annulipes* Wlk., *A. amictus amictus* Edw., *A. amictus hilli* Woodhill & Lee, *A. bancrofti bancrofti* Giles, *A. meraukensis* Venhuis and *A. stigmaticus* Skuse) or *A. longirostris* Brug from New Guinea. All fed on man, but the last two only with great reluctance. *A. punctulatus* was also the most long-lived species. There was little difference in length of life between *A. farauti*, *A. annulipes* and *A. amictus amictus*. Factors favouring longevity were a humid atmosphere, temperatures of about 70–75°F., a constant supply of carbohydrate food, not less than 6 cu. ins. space per mosquito and freedom from disturbance.

All the species became infected with *Plasmodium*. Only *A. longirostris* and *A. stigmaticus* showed relative insusceptibility. *A. punctulatus* was highly susceptible to *P. vivax* and *P. falciparum*, and complete development of *P. malariae* was observed in it in one experiment. The three Australian forms that were most readily available (*A. farauti*, *A. annulipes* and *A. amictus amictus*) were also highly and apparently about equally susceptible to *P. vivax* and *P. falciparum*. Complete development of both these parasites was observed in *A. b. bancrofti* and in *A. stigmaticus*. *P. vivax* in the oöcyst stage was seen in *A. meraukensis*, and *P. falciparum* in the same stage in *A. amictus hilli*. Neither of these mosquitos was abundant enough for further tests. Complete development of *P. falciparum* was observed in one female of *A. longirostris*, but an infection with *P. vivax* died out in the oöcyst stage in a small number of this species examined, although development occurred normally in a control batch of *A. punctulatus*. Considerable individual variation in susceptibility to infection was found in all species, and was most carefully studied in *A. punctulatus*. Totally insusceptible individuals are considered extremely rare, if they exist at all, but a very wide range of susceptibility exists. This might be due to variations in the amount of blood ingested, though only fully engorged females were normally used, uneven distribution of gametocytes in the blood, though no evidence to favour a hypothesis of unequal distribution of gametocytes in the peripheral circulation is known to the authors, hazards in the gut, and variable viability of the parasite. Considerable variation in the rate of development of the parasites was observed. The reason for it is unknown. There was no evidence for any of the species of mosquitos of difference in susceptibility to the species of *Plasmodium* tested. The strains of *P. vivax*

used were from New Guinea and those of *P. falciparum* from New Guinea and the Solomon Islands. There was complete failure in the only attempt made to infect *A. farauti*, *A. annulipes* and *A. amictus amictus* with a strain of *P. vivax* from Syria. *P. vivax* and *P. falciparum* were repeatedly transmitted to man by *A. punctulatus* and by mixed cultures of *A. farauti* and *A. annulipes*. *P. vivax* was also transmitted by *A. annulipes* to five volunteers and *P. malariae* by *A. punctulatus* to one volunteer.

Of the five factors that affect an Anopheline's ability to transmit malaria [**38** 201], the four that are relevant to a laboratory study are discussed. All the common species used were susceptible to infection, but *A. punctulatus* was outstanding as regards abundance, as colonies were readily established when suitable cages were provided [**37** 174], and it was also pre-eminent as regards avidity for human blood and length of life. Thus, the findings agreed fairly closely with field experience [**38** 201], though avidity for human blood appears the most important attribute in the field whereas longevity was even more important in the laboratory, and the laboratory experiments did not show any marked differences between *A. farauti* and *A. annulipes* [*cf.* **32** 161] whereas in the field the former is an important vector and the latter only transmits malaria sporadically.

KIRK (R.). **Observations on Onchocerciasis in the Bahr-el-Ghazal Province of the Sudan.**—*Ann. trop. Med. Parasit.* **41** no. 3–4 pp. 357–364, 10 refs. Liverpool, 1947.

Results are given of surveys made in several localities in the Bahr-el-Ghazal Province of the incidence of microfilariae of *Onchocerca volvulus* in the skin [*cf. R.A.E.*, B **23** 134]. Preserved and stained smears were used. Infection was fairly prevalent, and incidence in one onchocercosis area was high in persons having no onchocerca nodules or other signs of infection. The significance of this is discussed. The clinical signs and symptoms of infection seen in the Bahr-el-Ghazal region are described, with particular reference to blindness [*loc. cit.*].

Of the two African vectors of *O. volvulus*, *Simulium neavei* Roub. and *S. damnosum* Theo., only the latter has been identified in the Sudan. It is widely distributed through the areas where onchocercosis and endemic blindness occur and is presumed to be the principal and possibly the only vector. It has a well-marked seasonal incidence in the Bahr-el-Ghazal. The adults occur at the river all the year round, but few are seen in the dry weather and these not far from the river's edge. They are abundant in the rainy season (June–August) when they are found biting over 1,000 yards from the river.

VANDERPLANK (F. L.). **Seasonal and annual Variation in the Incidence of Trypanosomiasis in Game.**—*Ann. trop. Med. Parasit.* **41** no. 3–4 pp. 365–374, 15 refs. Liverpool, 1947.

The following is substantially the author's summary. Further data have been collected on the occurrence of various species of pathogenic trypanosomes in the blood of wild animals in Tanganyika [*cf. R.A.E.*, B **30** 163]. Including the animals dealt with in the previous paper, 378 individuals belonging to 38 species were examined by the author between June 1939 and June 1944. A high percentage of giraffe, kudu and roan antelope showed trypanosomes (*Trypanosoma congolense* or *T. vivax*) in the blood. Only a few individuals were found with *T. brucei*. *T. congolense* was found in the blood of an elephant. Carnivora, primates and rodents were all negative, although it is known that some species are very susceptible to all species of trypanosomes. There was no difference in infection-rates between young and adult animals [*cf. loc. cit.*]

or between males and females. There was a seasonal variation in the rates, which were highest during the rains (March–April and November–December), and an annual variation that was correlated with the number of tsetse flies (*Glossina*) found to be infective, and probably depends on the climatic conditions.

The results of dissecting some 35,000 males and females of *G. swynnertoni* Aust. and *G. pallidipes* Aust. taken at Shinyanga in 1941–44 are given, showing the separate figures for each sex and species. Some laboratory data are given on the course of infection of *T. rhodesiense* and *T. congolense* in captive wild animals. The blood-meals of engorged individuals of *G. swynnertoni* taken in nature were classified by measuring the erythrocytes ; giraffe and the larger antelopes were shown to be favoured. The results, together with other known facts, are discussed from an ecological point of view. Although the percentage of tsetses found infective was less than 0·1 for *T. brucei*, 2·2 for *T. congolense*, and 2·1 for *T. vivax*, it would appear that all the flies are exposed to infection. Under the natural climatic conditions, all the flies that would be expected, on the basis of laboratory observations, to become infective, do in fact become so.

Some 17 species of wild animals, represented by 72 individuals, were examined by W. E. F. Thomson in Northern Rhodesia in 1940–42. *T. vivax* was found in two out of seven roan antelopes and three out of 16 bush-pigs, a mixed infection of *T. vivax* and *T. brucei* in the only waterbuck examined, and a doubtful infection with *T. brucei* in one out of six buffalo.

Walton (G. A.). **On the Control of Malaria in Freetown, Sierra Leone. I. *Plasmodium falciparum* and *Anopheles gambiae* in Relation to Malaria occurring in Infants.**—*Ann. trop. Med. Parasit.* **41** no. 3–4 pp. 380–407, 7 figs., 53 refs. Liverpool, 1947.

The following is substantially the author's summary. During the first part of the recent war, malaria caused by *Plasmodium falciparum* became a serious menace to the convoy organisation in the port of Freetown, Sierra Leone [*cf. R.A.E.*, B **37** 197], and a reorganised campaign was begun in 1943 against the local vector, *Anopheles gambiae* Giles, both in the city and in the neighbouring districts. Measures against the larvae were co-ordinated with extensive house-catches of adult mosquitos and supplemented by localised spraying with pyrethrum. The numbers of infected Anophelines were quickly and drastically reduced.

Methods are described of investigating malaria in African infants to measure quantitatively the effect of the control measures on the rate of malaria infection in the human population. It is shown that the control achieved was almost completely effective in Freetown. By 1945, only 5–7 per cent. of African infants in Freetown were carrying malaria infections at the age of two years. It is suggested that most of these infections were contracted outside the city. A parasite index of 5 per cent. in infants was found to result when one in every four infants was infected in 18 months. Previous work on malaria in African infants is reviewed and shows that, in widely separated parts of Africa where *A. gambiae* was a vector, all infants had infections by the age of 2–3 years. Parasite rates of African infants and children were estimated from observed Anopheline abundance and infection rates, and were confirmed by blood examination.

Malaria and other Insect-borne Diseases in the South Pacific Campaign, 1942–1945.—*Amer. J. trop. Med.* **27** no. 3 suppl. v+128 pp., illus., refs. Baltimore, Md., 1947.

This is a collection of four papers dealing primarily with malaria, the most serious health hazard to which United States troops in the South Pacific area

were exposed during the second World War, but including also brief discussions of the other arthropod-borne diseases that had to be taken into consideration. The findings of many workers are incorporated in the papers, in which an attempt is made to deal comprehensively with the malaria control programme of the area. This included 11 malarious and numerous non-malarious bases spread over many thousands of miles.

In the first paper, **General Aspects and Control Measures** by P. A. Harper, E. T. Lisansky & B. E. Sasse (pp. 1–67, 9 figs., 20 refs.), introductory notes on the situation with regard to malaria, dengue, filariasis caused by *Filaria* (*Wuchereria*) *bancrofti* and tsutsugamushi disease in the early months of the occupation, brief accounts of the physical geography and climate of the area and a table showing the dates of occupation of malarious islands are followed by descriptions of the area organisation and procedure, base or island organisation and procedure and training and education programmes. Details are given of the enforcement of various control measures, namely individual protection against mosquitos, segregation of natives by careful choice of camp sites, etc., clearing of streams, application of larvicides from the ground (paris-green dust, oil and later DDT solution or dust) or from aircraft (DDT solution) [*cf. R.A.E.*, B **36** 84], measures directed against adult Anophelines (use of pyrethrum aerosols and DDT preparations as sprays to leave a toxic deposit and for impregnating bed nets), screening, semi-permanent and permanent control work and suppressive medication. An example of standard operating procedure for the control of malaria and other insect-borne diseases during a combat operation is given in an appendix.

In the second paper, entitled **Epidemiology of Insect-borne Diseases in Army Troops** by W. G. Downs, Harper & Lisansky (pp. 69–89, 12 graphs, 3 refs.), malaria rates in all forces on the chief bases in the South Pacific campaign are given with brief accounts of the situation on each base, and similar data are given for selected army units that proceeded from base to base. A brief note on dengue epidemics on New Caledonia and Espiritu Santo (New Hebrides) is included.

The third paper, **Entomology**, by P. W. Oman & L. D. Christenson (pp. 91–117, 5 figs., 9 refs.), is compiled mainly from observations made on Efate (New Hebrides), Espiritu Santo, and Guadalcanal and Bougainville in the Solomon Islands. While only 12 species of mosquitos are known from New Caledonia and 18 from Espiritu Santo, about 70 are known to occur on Guadalcanal, and Bougainville may be expected to have even more. The topography and climate of the main islands are discussed.

Anopheles farauti Lav. was by far the most important and probably the only important vector of malaria in the South Pacific area [*cf.* **34** 122]. *A. punctulatus* Dön., *A. lungae* Belkin & Schlosser, *A. koliensis* Owen, *A. solomonis* Belkin, Knight & Rozeboom and *A. nataliae* Belkin were found on Guadalcanal [**35** 161, 163] but were seldom numerous enough to be major factors. *A. koliensis* is strongly anthropophilous [*cf.* **35** 161] and *A. punctulatus* fed freely on man in captivity but apparently only rarely in nature [**35** 163]. *A. farauti* is adapted to a great range of larval habitats [*cf.* **36** 84]. Notes are given on the adult habits of this species and on the breeding places in which it and other Anophelines were found. There was considerable evidence of the existence of at least two races or physiological strains of *A. farauti* on Guadalcanal. Females reared in large numbers from larvae collected outside the zone of normal human habitation would not feed readily on man in captivity, whereas insectary colonies established from eggs obtained from blood-fed females collected in native huts or from larvae collected near dwellings usually produced females that fed readily in captivity. Host preference tests carried out on Efate indicated that *A. farauti* would feed readily on cattle, horses, goats, pigs, dogs and fowls and that both cattle and horses are preferred to man.

It is not implied that these physiological strains, if they exist, are fixed in their food habits. Control operations, which were begun before DDT was known, consisted of a combination of permanent and temporary measures, including clearing and flushing of streams, which gave good results, and the elimination of vegetation and floatage from lagoons, usually by opening the lagoon to the sea periodically to allow of drainage or tidal action and salinification. Salinity aided control only by contributing to the elimination or change of vegetation. Barrel-type flumes were among the most effective and economical devices. In addition to the flushing action, they caused a great reduction in water surface. The most important breeding places were man-made. Rutted areas were eventually dealt with by thorough disking, in conjunction with proper ditching and road construction. These measures were used in conjunction with larvicides.

The only proved vector of dengue fever that is common in the South Pacific area is stated to be *Aëdes aegypti* (L.), which was apparently responsible for severe outbreaks on New Caledonia, Efate, Espiritu Santo and Tulagi-Florida in 1943 and for a mild outbreak on New Caledonia in 1944. It was not known to occur in the occupied part of Guadalcanal until a localised infestation was found in November 1943. It was eliminated by the middle of 1944. *A. scutellaris* (Wlk.) (*hebrideus* Edw.) is apparently an important vector on Espiritu Santo [*cf.* **34** 37 ; **36** 174 ; also **37** 182].

Infection with *Filaria bancrofti* is common in the South Pacific but was not of military importance except in Polynesia, where the vector is *A. pseudoscutellaris* (Theo.) [*cf.* **34** 37]. Observations subsequent to the occupation indicate that the chief vectors in the New Hebrides and Solomon Islands are species of *Anopheles*, particularly *A. farauti* [*cf.* **34** 123 ; **37** 10], though *A. koliensis* appears to be an efficient vector.

Notes are given on mosquitos of importance as persistent biters (many species of *Aëdes*, principally *A. vigilax* (Skuse), and *Culex annulirostris* Skuse). Flies of note included *Musca sorbens* Wied. and an undetermined species which were present in great numbers on Efate and Espiritu Santo early in 1943 and were thought to be largely responsible for outbreaks of bacillary dysentery. They were persistent in attempts to feed on any open sore or wound and would fly into the mouth, nostrils, eyes or ears. Normal sanitary measures and the removal of cattle from adjacent groves usually sufficed to reduce their numbers. *Chrysomyia megacephala* (F.) was extremely abundant in and around garbage pits and latrines in the Solomons and to some extent the New Hebrides [*cf.* **36** 86]. *Hermetia illucens* (L.) was common in latrines on Guadalcanal, but is not known to have any importance in connection with disease. *Styloconops* (*Acanthoconops*) *albiventris* (de Meij.) was abundant and bit freely in some beach areas in Guadalcanal [*cf.* **37** 78], but is not known to transmit disease there.

Tsutsugamushi disease, transmitted by Trombiculid larvae, was found on Espiritu Santo, Munda (New Georgia group) and Bougainville, but only on Bougainville was there evidence of any considerable reservoir of the disease. Individual protective measures, particularly avoidance of habitats likely to harbour mites and use of dimethyl phthalate on skin and clothing [**37** 92] appeared to give the best protection. Information as to the efficacy of cutting and burning vegetation thought to harbour the Trombiculid larvae and their hosts is not conclusive.

Details are given of the organisation of survey activities and of duties and procedure, including mapping ; the faults apparent in the organisation and operation of entomological work in the South Pacific area are also discussed.

The following is based on the authors' summary of the fourth paper. **Parasitological Observations on Malaria in Natives and Troops, and on Filariasis in Natives,** by N. D. Levine & Harper (pp. 119–128, 1 graph, 2 refs.). Malaria parasite rates found between 1942 and 1944 among natives of the Solomon

Islands, New Hebrides and Bismarck Archipelago (Green and Emirau Islands) show that malaria is hyperendemic in the area. *Plasmodium vivax*, *P. falciparum* and *P. malariae* are all present, the first being the most common. The incidence of splenomegaly among natives varied from 34 to 85 per cent. on different islands.

The percentages of natives showing microfilariae of *F.* (*W.*) *bancrofti* varied from 4 on New Caledonia to 39 on Emirau and was 22 on Guadalcanal and Espiritu Santo, 24 in the Samoan area [*cf.* **34** 38] and 30 in Fiji. Nocturnal periodicity was noted on Guadalcanal, Espiritu Santo and Emirau, whereas there was no periodicity in Samoa or Fiji [*cf.* **34** 37, 123 ; **37** 10 ; **38** 146]. This could be correlated with the habits of the vectors. *F.* (*W.*) *malayi* was found in 9 per cent. of imported Indo-Chinese labourers on Espiritu Santo but not among the natives on any of the islands surveyed.

In the early part of the South Pacific campaign, *P. falciparum* was the predominant parasite causing malaria among troops, but with the decline in the incidence of the disease as the campaign progressed, the ratio of *P. falciparum* to *P. vivax* decreased, until the latter was much the more common. Upon removal of troops from a malarious area, *P. vivax* rapidly became the predominant cause of malaria among them.

HINMAN (E. H.) & CUTKOMP (L. K.). **Block residual Spraying of Premises with DDT for the Control of Malaria.**—*Amer. J. trop. Med.* **27** no. 4 pp. 449–461, 1 map, 7 refs. Baltimore, Md., 1947.

In view of promising results obtained in 1945 by treating 3,150 houses within a mile of the Kentucky, Wheeler and Guntersville Reservoirs in the Tennessee Valley with a DDT spray to leave a toxic residue for the control of *Anopheles quadrimaculatus* Say [*cf. R.A.E.*, B **34** 189 ; **37** 79–80] and also of the findings of Hess & Keener [**38** 70], a large-scale experiment was made near Wheeler Reservoir, northern Alabama, in 1946 in which the interiors of all structures on 299 premises in a block covering over 38 sq. miles were sprayed in June with 5 per cent. DDT in emulsified xylene at about 200 mg. DDT per sq. ft. Barns were sprayed to a height of 10 ft. only. A similar block was kept untreated as a control. More than 25 per cent. of all premises in the two areas were inspected three times each month in July, August and September and densities of *A. quadrimaculatus* recorded. The average numbers per property in the sprayed and control areas before treatment were 20·09 and 23·3, respectively. The average number per property in the sprayed area rose gradually from 0·4 at the beginning of July to 1·1–1·2 in August and 6·2 at the end of September, while the number in the control area varied from 32·9 in early July to 14·2 at the end of September with a peak of 43·8 in early August. There were also marked reductions in the treated area when the numbers of Anophelines in houses only were compared, though the numbers involved were small. Even before spraying, very few (1·07 and 0·4) were found in occupied houses as compared with barns, irrespective of whether the houses were screened or not. It is possible that this low density in houses may be associated with the application of insecticidal sprays and repellents by the occupants. Counts in the unsprayed half of an experimental barn and in nail kegs [*cf.* **31** 52] showed that Anopheline density remained high throughout the spraying season, and comparison of density of larvae in the reservoir and other breeding places in sprayed and unsprayed areas also failed to give evidence of any significant decline in mosquito population in the treated area. The added cost of spraying all structures was not more than one-third of the cost of spraying houses only.

On the basis of previous information on the habits of *A. quadrimaculatus* and the present observations on the effect of treating all structures, it appears that

this complete treatment offers more protection against malaria than mosquito-proofing with its practical limitations. The importance of treating large blocks of premises is emphasised.

WISSEMAN jr. (C. L.) & SULKIN (S. E.). **Observations on the Laboratory Care, Life Cycle, and Hosts of the Chicken Mite,** *Dermanyssus gallinae*.—*Amer. J. trop. Med.* **27** no. 4 pp. 463–469, 1 pl., 3 figs., 13 refs. Baltimore, Md., 1947.

Observations on the life-cycle and hosts of *Dermanyssus gallinae* (Deg.) and a method of rearing and handling it are described in view of the desirability of experiments on the part it may play in the dissemination of equine encephalomyelitis [*R.A.E.*, B **33** 88–89]. The mites were obtained in nature in Texas. They were collected and transferred by means of a simple suction device, a diagram of which is shown. Those required for immediate use were kept at room temperature and a relative humidity of 70 per cent., and others were stored at 4–5°C. [39·2–41°F.]. They were usually fed every 3–4 weeks and left at room temperature for a few days to allow of oviposition and hatching. The small tubes in which the mites were kept in the refrigerators were sealed in larger test tubes to prevent excessive condensation. Feeding was usually on young fowls in a culture flask. Descriptions are given of three methods used to seal the cloaca of the fowl to avoid the risk of mites being drowned in the excreta. It was often necessary to direct an air current into the flask to prevent condensation. In addition to fowls, mites fed readily on pigeons and English sparrows, but they could not be induced to feed on white mice, white rats or man, or on freshly-drawn fowl blood *in vitro*. The tops of all containers used in feeding were covered with fine-mesh cloth. A mite colony was established in a small screened hen coop with a screened run and a roosting box with a hinged roof. Numerous wooden slats were lightly nailed about the inside of the box, and mites could easily be found by lifting these with a knife blade.

Adult females usually began to oviposit 12–24 hours after feeding and laid as many as seven eggs. These hatched 48–72 hours later at summer temperatures. Larvae moulted to first-stage nymphs in 24–48 hours without feeding, and first-stage to second-stage nymphs 24–48 hours after a blood-meal. Another feed soon after the moult was usually followed promptly by moulting to the adult form. Feeding took place mainly at night. A list is given of hosts other than fowls, from which the mites have been recorded, with the author of each record, and the question of the mites attacking man in nature is briefly reviewed from the literature.

WADDELL (M. B.) & TAYLOR (R. M.). **Studies on the cyclic Passage of Yellow Fever Virus in South American Mammals and Mosquitoes. III. Further Observations on** *Haemagogus equinus* **as a Vector of the Virus.**—*Amer. J. trop. Med.* **27** no. 4 pp. 471–476, 8 refs. Baltimore, Md., 1947.

In this third paper of a series [*cf. R.A.E.*, B **36** 114 ; **37** 214], an account is given of further experiments in which a strain of jungle yellow fever was maintained by alternate passage through marmosets (*Callithrix aurita* or *C. penicillata*) and a Colombian strain of *Haemagogus equinus* Theo. for seven cycles, after which the passages were voluntarily discontinued. The efficiency of *H. equinus* as a vector was compared with that of a Brazilian strain of *Aëdes aegypti* (L.) by submitting them to the same experimental conditions and by allowing them to feed individually on baby mice at different periods following the infective meal. Under these conditions, 72 of 164 females of *A. aegypti* and 38 out of 163 of *H. equinus* transmitted the virus, thus giving an index

of 0·53 for *H. equinus* as compared with an assumed index of 1 for *A. aegypti*. Differences between the transmission rates of the two species were considerable only when the virus titre in the source animal was high.

BUTTS (D. C. A.). **Filarial Infection in Costa Rica.**—*Amer. J. trop. Med.* **27** no. 5 pp. 607–615, 4 maps. Baltimore, Md., 1947.

A survey of 1,306 persons from four coastal areas of Costa Rica was made in 1946 to determine the presence and distribution of individuals infected with microfilariae. The fact that these were sheathed and of nocturnal periodicity confirms their identification as *Filaria* (*Wuchereria*) *bancrofti*. The incidence of infection ranged from 1 per cent. on the Pacific Coast to 15 per cent. in certain areas on the Atlantic Coast. Data are given on age and racial incidence. There is little doubt that the infection was imported from the West Indies, that its endemic focus is Limon and that it will spread throughout the country unless rigid mosquito control is enforced. A collection of 213 larvae and 123 adults of mosquitos from the yards and houses of infected native-born individuals in the Limon area was found to include 173 larvae and 14 adults of *Aëdes aegypti* (L.) and 27 larvae and 58 adults of *Culex fatigans* Wied. (*quinquefasciatus* auct.). *C. fatigans*, the outstanding proved vector, was the predominating mosquito in the section of the town where the incidence of filariasis was highest, and probably transmits the infection locally.

DE CAIRES (P. F.). *Aëdes aegypti* **Control in the Absence of a piped potable Water Supply.**—*Amer. J. trop. Med.* **27** no. 6 pp. 733–743, 12 figs., 3 refs. Baltimore, Md., 1947.

The eradication of *Aëdes aegypti* (L.) from Georgetown, British Guiana, is rendered very difficult by the absence of a piped supply of drinking water and the consequent tendency of the population to hoard water in containers of various types. The difficulty is increased by the abnormally short life-cycle, which sometimes lasts only four days. An account is given of the special problems that had to be solved during a control campaign begun in 1939 and the solutions adopted.

The classical control measures were used until the end of 1945, but during this period the *aegypti* index was not reduced below one and continued to fluctuate with rainfall. At the beginning of 1946, spraying of the interiors of houses with 5 per cent. DDT in kerosene at 100 mg. DDT per sq. ft. was substituted [*cf. R.A.E.*, B **38** 68–69], and the index was reduced to zero by the end of the year. Spraying with DDT was moreover cheaper than using routine measures.

LINDUSKA (J. P.) & MORTON (F. A.). **Benzene Hexachloride for Area Control of Trombiculid Mites.**—*Amer. J. trop. Med.* **27** no. 6 pp. 771–777, 4 refs. Baltimore, Md., 1947.

In view of the results of preliminary experiments [*R.A.E.*, B **37** 168], further tests of crude BHC (benzene hexachloride containing about 12 per cent. γ isomer) for the control of Trombiculid larvae on the ground were made in Florida, some under practical conditions in habitats where the predominant species of mites were *Eutrombicula* (*Acariscus*) *masoni* (Ewing) and *E. alfreddugèsi* (Oudm.). When it was used in two experiments as a 3 per cent. spray in fuel oil at about 6 lb. BHC per acre and as a 10 or 25 per cent. dust in talc at 10 lb. per acre, control was about 90 per cent. or over on all days on which counts were made for 30 days except on the 16th day in one test when there was a general increase in mite populations and control by the spray was only

85 per cent. A 12 per cent. spray in cyclohexanone dispersed by aeroplane gave immediate and lasting control at 6–13 lb. BHC per acre. Control was nearly complete within an hour and remained so for at least 30 days. Preliminary field tests indicated that BHC is effective against mites largely as a fumigant. This characteristic, which was found to allow of good control without uniform coverage, would also appear to adapt it for use in areas of tall, heavy herbaceous growth.

Complete control of mites in circumscribed areas was obtained by hand broadcasting of coarse materials, such as sawdust or small pieces of rope, that had been impregnated with BHC in acetone solution. The dosage necessary for control by this method was greater than that needed by others, and appeared to be strongly regulated by the nature of the ground cover. In areas covered by a dense vegetative growth, a rapid and practical control was obtained when as little as 10 lb. BHC per acre was used, but in plots with moderate ground cover, 20–40 lb. per acre was needed for the satisfactory elimination of mites.

Rempel (J. G.). **A Guide to the Mosquito Larvae of western Canada.**—*Canad. J. Res.* (D) **28** no. 4 pp. 207–248, 43 figs., 1 map, 14 refs. Ottawa, 1950.

The following is the author's abstract. Keys to the genera and species of mosquito larvae of the four western provinces of Canada are presented. To facilitate identification the generic and specific characters used in the keys are fully illustrated. A map of Western Canada showing the main vegetation Zones and the principal areas of intensive mosquito collecting is included. Six genera and 46 species are represented in the mosquito fauna of Western Canada, namely *Anopheles* with four species, *Mansonia* with one species, *Wyeomyia* with one species, *Culiseta* with five species, *Culex* with four species, and *Aëdes* with 31 species.

Leví Castillo (R.). **Estudios sobre el paludismo en los valles andinos de Sudamérica.** [Studies on Malaria in the Andine Valleys of South America.] —*Rev. méd. Cordoba* **35** pp. 543–550, 8 refs. Cordoba, 1947.

The author briefly describes the mountain system of the Andes, gives a list of the mountain valleys in Colombia, Ecuador, Peru, Bolivia, Chile and Argentina in which malaria occurs, and points out that this high-altitude malaria has similar characters wherever it is present. It is due to *Plasmodium malariae* or *P. falciparum*, restricted in distribution by mountain barriers, and usually transmitted by *Anopheles pseudopunctipennis* Theo. [*cf. R.A.E.*, B **36** 52 though *A. punctimacula* D. & K. has been recorded as the most important vector in the Medellín Valley of Colombia [*cf.* **37** 11]. *A. pseudopunctipennis* has local varieties differing in breeding habits, ecology and physiology [*cf.* **37** 177] and breeds in water with an average temperature between 18 and 22°C. 64·4 and 71·6 F.] and a pH of 7·5–9. The variety that occurs at high altitudes [*cf.* **34** 40] is larger than the coastal variety ; the dimensions of the adults are given. It breeds in sunny pools left by mountain streams after they have ceased to be swollen by the rains and melted snow [*cf.* **36** 52]. These pools soon become covered with *Spirogyra*, which is necessary for larval development. Pools formed by subterranean water and covered by the algae are also favoured. The adults are highly anthropophilous, and in the Rimac Valley, Peru, the author found them sheltering in large numbers beneath beds and in the reed roofs of native dwellings. Because of the general slope of the valleys, drainage is fairly simple to arrange, and *A. pseudopunctipennis* was eradicated by this means from one valley in Ecuador **34** 165]. Spraying houses with DDT may prove a powerful supplementary measure, and though each valley presents its own special problems, it should not be impossible ultimately to free them all from the disease.

Wilson (D. B.). **Malaria in Madagascar.**—*E. Afr. med. J.* **24** no. 4 pp. 171–176, 5 refs. Nairobi, 1947.

Malaria is endemic over practically the whole of Madagascar, partly no doubt on account of the high rainfall in the north and east and the large stretches of rice swamps in the high central area. In other parts of the island, the vector Anophelines breed mainly in slow-running rivers, seasonal eroded streams, seepages and riverine swamps. Figures of the incidence of malaria among troops during the occupation of 1942–45 show that it was very high during the first month after landing when infections were acquired in the valleys where the disease is hyperendemic and in the absence of any control, and relatively low in the urban and protected area around Diego Suarez in 1944–45. Spleen and parasite rates among the indigenous population in two areas near Diego Suarez showed that the disease was fully hyperendemic and that the people acquired a high degree of immunity. *Plasmodium falciparum* was the predominant parasite.

Anopheline surveys were made at several places in 1943, and larvae of some 14 species were found and are recorded. The predominant vector on the northern and western coasts was *Anopheles gambiae* Giles ; elsewhere it was *A. funestus* Giles. The average catch of each species in houses at various altitudes is shown in a table, and average monthly catches of vector species in areas where control measures were in force and outside these areas are compared. All control measures were temporary. It is shown that control by such means as the application of larvicides from the ground is impracticable in the upland towns surrounded by rice-growing areas. In the Diego Suarez area, control measures were continued for much longer than elsewhere and were effective in spite of intense breeding by *A. funestus*.

Piedrola Gil (G.). **Práctica de la moderna desinsectación.** [The Practice of Modern Insect Control.]—$8\frac{1}{2} \times 5\frac{1}{2}$ ins., xix + 210 pp. 37 figs. (1 fldg.), 10 fldg. tables. Madrid, Gráfica Administrativa, 1950. Price 70 *pesetas*.

This book deals in the main with the control of arthropods that attack man by the use of DDT and BHC (benzene hexachloride). It is written with special reference to Spanish conditions and is based on research and experience gained in many countries during and since the late war. The introductory chapters contain accounts of the morphology of insects and features that render them susceptible to contact insecticides, the physico-chemical properties of modern synthetic insecticides in general and of DDT, BHC and chlordan in particular, the toxicology of DDT and BHC and the ways in which they are prepared for use. The next chapters deal with the technique of applying these two materials in houses in sprays, dusts and aerosols and with control of various pests or groups of pests, with notes on the habits of each group. The last chapter comprises brief sections on fumigation with hydrocyanic acid gas.

Smit (F. G. A. M.). **Vlooien en luizen.** [Fleas and Lice.]—*Wat leeft en groeit* no. 27, 152 pp., 16 pls., 22 figs. Utrecht, Het Spectrum [? 1950].

This booklet gives Dutch readers a comprehensive but mainly non-technical account of the habits and importance of the Siphonaptera, Mallophaga and Anoplura. It has special reference to conditions in the Netherlands, but much of the matter is of wider interest. The sections dealing with the three groups contain general accounts of their morphology and life-history, illustrated by references to typical or important species, and special attention is given to the species that attack man, separate sections being devoted to *Pulex irritans* L., *Pediculus humanus humanus* L., *P. h. capitis* Deg. and *Phthirus pubis* (L.). The hygienic importance of fleas and lice is explained in some detail, and lists of the fleas and Anoplura of the Netherlands, showing their hosts, and a list of mammals and birds, showing the Mallophaga that attack them there, are included.

Leclercq (M.). *Crataerina pallida* **Leach (Dipt. Hippoboscidae), parasite de l'homme.**—*Bull. Ann. Soc. ent. Belg.* **84** pt. 7–8 pp. 144–145. Brussels, 1948.

Crataerina pallida (Latr.) was found in some numbers in a house in the centre of Liège in July 1948, and attacked the inhabitants by day and night. They had probably carried the Hippoboscids to the house in their clothing as they had visited an area where swifts were fairly numerous. *C. pallida* is known to infest swifts and to be fairly common in the Liège district.

Baroni (O.) & Egli (R.). **Combate ao carrapato do gado bovino com DDT.** [Control of the Cattle Tick with DDT.]—*Biológico* **14** no. 5 pp. 109–112, 1 pl., 2 graphs. São Paulo, 1948.

Arsenical dips have proved unsatisfactory against *Boophilus annulatus microplus* (Can.) on cattle in São Paulo [*cf. R.A.E.*, B **38** 85], and since DDT has been reported to give good control of various ticks, it was tested in 1946 [*cf.* **38** 150]. Various lots of infested cattle on a farm at Campinas were sprayed at high pressure with 1 per cent. DDT from a 50 per cent. powder at intervals of 14-36 days. It was observed that larvae, nymphs and males all died on the day after treatment, and the adult females in 5–6 days. The animals then remained free from infestation for over 20 days, the larvae that attacked them dying within about 24 hours. When the interval between applications was greater than this, reinfestation occurred.

Khayyat (S. M.) & Gilder (A. A.). **Ovine Piroplasmoses in Iraq.**—*Trans. R. Soc. trop. Med. Hyg.* **41** no. 1 pp. 119–126, 1 pl., 25 refs. London, 1947.

During the last week of September 1943, an outbreak of piroplasmosis caused by *Theileria hirci* occurred among sheep in Baquba, eastern Iraq. Mortality was estimated to be over 20 per cent. Outbreaks in May 1944 among sheep in the Mosul and Erbil Districts (northern Iraq) were found to be due to *Piroplasma* (*Babesia*) *motasi* and mixed infections of *P. motasi* and *T. hirci*, respectively, and an outbreak of anaplasmosis caused by *Anaplasma ovis* occurred in Sulaimaniyah (north-eastern Iraq) in June. A mixed and fatal infection with *A. ovis* and *P. motasi* was seen near Baghdad in September. Schizonts (Koch's blue bodies) of *T. hirci* were demonstrated in the peripheral blood for the first time. All three parasites are recorded for the first time from Iraq, where serious losses of sheep, many probably attributable to them, are common. Attention is drawn to the natural occurrence of double infections.

Hyalomma dromedarii Koch, *Rhipicephalus sanguineus* (Latr.) and *Haemaphysalis cinnabarina punctata* C. & F. were collected from sheep in the areas where the outbreaks occurred, but no transmission experiments were made.

A trypanosome, possibly *Trypanosoma melophagium*, was also seen for the first time in Iraq, in the peripheral blood of a sheep.

Garnham (P. C. C.), Davies (C. W.), Heisch (R. B.) & Timms (G. L.). **An Epidemic of Louse-borne Relapsing Fever in Kenya.**—*Trans. R. Soc. trop. Med. Hyg.* **41** no. 1 pp. 141–170, 1 pl., 7 figs., 37 refs. London, 1947.

An account is given of an epidemic of relapsing fever, with nearly 2,000 cases and 40 per cent. mortality among untreated ones, that occurred in the hinterland of Mombasa and the Kenya Coast in 1945. The disease was introduced from Arabia. Infected lice, *Pediculus humanus humanus* L. (*P. h. corporis* Deg.) were recovered from patients, and the disease was transmitted from these lice to monkeys by inoculation. The floors of 50 infected native huts were searched for *Ornithodoros* without success, and *O. moubata* (Murr.) and *O. savignyi* (Aud.) failed to transmit the spirochaete.

The epidemic, which is thought to have been the first of the louse-borne type in East Africa, was rapidly terminated by control measures, the chief of which was the dusting of the bodies and hair of about 100,000 people (nearly all those in the infected area at the time) and their clothes and bedding with 5 per cent. DDT powder to kill lice [including *P. h. capitis* Deg.], supplemented by administrative measures to restrict travel, etc.

Dusting procedure is described in detail and clinical features, pathology and treatment are also discussed at length. Various systems of classifying relapsing-fever spirochaetes are cited, and it is shown that the spirochaetes of louse-borne relapsing fever have been diversely regarded as separate species and as strains of *Spirochaeta recurrentis*. The susceptibility to these strains or species of various laboratory animals is shown in a table, the behaviour of the Kenya strain in man and lice is compared with that of other strains and the results of experiments in which it and a strain of the tick-borne *S. duttoni* were transmitted by inoculation to animals are recorded. In its behaviour in animals, the Kenya strain corresponded fairly closely with that from India designated *S. carteri*. It showed a negative phase in the louse lasting 9–15 days, during which no spirochaetes were found, similar to that recorded for Europe [*R.A.E.*, B **12** 171] and North Africa [**3** 59], whereas spirochaetes have been found continuously in lice from cases in China [**25** 23] and Abyssinia [**35** 98]. It is suggested that the louse-borne spirochaetes may be divided into two groups according to the presence or absence of the negative phase.

Armaleo (G.). **Su un tentativo di trasmissione di febbre ricorrente africana a mezzo di** *Cimex lectularius*. [An Attempt to transmit African Relapsing Fever by Means of *C. lectularius*.]—*Arch. ital. Sci. med. colon. Parassit.* **30** fasc. 11–12 repr. 4 pp., 6 refs. Rome, 1949. (With Summaries in German, English and French.)

Since *Cimex lectularius* L. has been thought by some to be an occasional vector of *Spirochaeta duttoni*, the causal agent of African relapsing fever [*cf. R.A.E.*, B **20** 23 ; **28** 137], the author took advantage of four native cases of the disease in Somalia in 1946 to test this. Hungry bugs were confined for several hours on the arm and thorax of two of the patients during periods when these had temperatures of at least 39°C. [102·2°F.] and spirochaetes were easily demonstrable in the peripheral blood, but they refused to feed, though they did so on the same patients after the fever had been reduced by drugs. Smears from them were then negative for spirochaetes, as also were those from engorged bugs kept for ten days before testing. Similar results were obtained with the other patients, on whom the bugs were placed during and between febrile periods, and it is tentatively concluded that since the bugs do not feed on febrile patients, they cannot serve as vectors.

Papers noticed by Title only.

Gil Collado (J.). **Las especies españolas de afanípteros.** [The Spanish Species of Fleas.]—*Eos* **24** pt. 2 pp. 247–256, 1 pl., 7 refs. Madrid, 1948.

Gersdorff (W. A.) & Mitlin (N.). **Insecticidal Action of American Species of** *Heliopsis* [tested in sprays on *Musca domestica* L.].—*J. econ. Ent.* **43** no. 4 pp. 554–555, 3 refs. Menasha, Wis., 1950. [See *R.A.E.*, A **39** 122.]

Stohlman (E. F.), Thorp (W. T. S.) & Smith (M. I.). **Toxic Action of Chlordan** [on rats and rabbits].—*Arch. industr. Hyg. occup. Med.* **1** pp. 13–19, 1 graph, 9 refs. Repr. (with additions) 7 pp. Chicago, Ill., 1950. [See *R.A.E.*, A **39** 126.]

Dick (G. W. A.) & Lewis (E. A.). **A rickettsial Disease in East Africa transmitted by Ticks** (*Rhipicephalus simus* and *Haemaphysalis leachi*).—*Trans. R. Soc. trop. Med. Hyg.* **41** no. 3 pp. 295–326, 4 pls., 14 figs., 26 refs. London, 1947.

An account is given of investigations into the etiology, transmission and histology of a rickettsial disease of which an outbreak occurred among Air Force personnel and prisoners of war in the Port Reitz area of Kenya in 1944–45. The course was mild and there were no deaths. Incidence was greatest in the rainy seasons. Most of the camps where the disease occurred were on otherwise unoccupied land with tall, rank grass or scrub. The cases decreased rapidly among the prisoners of war when long grass was put out of bounds, and as soon as possible cut. No lice [*Pediculus humanus* L.] were found at any of the camps, fleas were few, and no mites were seen in areas where infection was recorded. Ticks, on the other hand, were abundant on the tips of long grass beside roads and paths. Those collected from grass, dogs or cattle included *Rhipicephalus simus* Koch, *R. sanguineus* (Latr.), *R. pulchellus* (Gerst.), *R. appendiculatus* Neum., *Amblyomma variegatum* (F.), *A. gemma* Dön., *A. lepidum* Dön. and *Haemaphysalis leachi* (Aud.). Most were adults, and larvae were rare. *R. simus*, which is perhaps the most abundant and widely distributed tick in the coastal belt of Kenya, was the commonest. It predominated on cattle and had a marked predilection for the grass, but was less common than *R. sanguineus* on dogs. The other species were relatively infrequent. No infestation of huts or offices, similar to that in some houses where dogs are kept, was seen, but 15 adults of *R. simus*, 5 of *R. sanguineus* and 3 of *R. pulchellus* were taken in the huts. Five inoculation experiments with *R. pulchellus*, three with *R. appendiculatus*, two with *A. variegatum* and one each with *A. gemma*, *A. lepidum* and *R. capensis* produced no reactions in laboratory animals, and 12 with *R. simus* and seven with *H. leachi* also proved negative. However, in two experiments each with *H. leachi* and *R. simus*, intraperitoneal inoculation of macerated ticks into guineapigs produced a disease identical with that produced by inoculation of blood from human cases and there was a scrotal reaction in the animals. The details are shown in a table ; rickettsiae were demonstrated in one batch of each tick. Tests with *R. sanguineus* [*cf. R.A.E.*, B **23** 262] produced only pyrexia. The disease was more severe in the guineapigs inoculated with *H. leachi* than in those inoculated with *R. simus* or human blood, and the same was true of passage animals. There was also a difference in the severity of the reactions caused by various samples of blood. This was believed to be related to a difference in the species of tick that had transmitted the disease to the human host.

There was a primary lesion in about 80 per cent. of the cases [*cf.* **25** 12], the more usual sites being the scrotum, groin or umbilical region. The development of the eschar appeared to be associated with friction, and the division of cases into those with a primary lesion and those without was thought to serve no useful purpose. Results of Weil-Felix agglutination tests are tabulated. None of the 59 sera showed "total" titres with Proteus OX19 or OX2 above the upper limits of normality, and only one showed significant total agglutination with OXK. However, the "standard" titres obtained with OXK were surprisingly high. Similar results have been obtained with certain strains of Rocky Mountain spotted fever, and it is concluded that the test is not reliable diagnostically in mild rickettsial infections.

The disease is believed to be the same as others with a similar syndrome that occur sporadically throughout Kenya, Tanganyika and Uganda and adjacent territories, to be tick-borne and to be acquired principally from ticks on long grass. It is similar to the disease often recorded in East Africa as "tick typhus" [or tropical typhus] and known to have occurred there since

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1914 [*cf.* **19** 40 ; **21** 107 ; **23** 261 ; **25** 12] and it may be identical with it. Cases have been reported recently in Kenya, Uganda, Tanganyika, Eritrea, the Anglo-Egyptian Sudan, Ethiopia, Somalia and British Somaliland. It cannot be definitely stated yet whether the disease is uniform throughout East Africa, and there may be variations associated with the vector species. The most suitable name for the condition is discussed. Since it probably belongs to the same group as Rocky Mountain spotted fever, it would be better designated as " East African spotted fever " or " East African tick bite fever " than as " tick typhus ", but the last name is retained as it is in current use and a change might lead to confusion in the differentiation of other types of rickettsial disease of man in East Africa and adjacent territories.

One case of murine typhus was found in Mombasa during the work.

Montgomery (T. H. L.) & Budden (F. H.). **Typhus in Northern Nigeria. I. Epidemiological Studies.**—*Trans. R. Soc. trop. Med. Hyg.* **41** no. 3 pp. 327–337, 2 figs., 2 graphs, 3 refs. London, 1947.

Findlay (G. M.) & Elmes (B. G. T.). **II. Laboratory Investigations.**—*T.c.* pp. 339–352, 11 refs.

Montgomery (T. H. L.) & Budden (F. H.). **III. Clinical Studies.**—*T.c.* pp. 353–362, 3 graphs, 2 refs.

These three papers are concerned with an outbreak of louse-borne typhus that occurred in Jos native town, Northern Nigeria, from June to September 1945 and is thought to be the first reported from British West Africa.

The first paper includes an account of the control of the epidemic by isolation of patients and by dusting the population, their clothing (including spare garments) and bedding with 5 to 10 per cent. DDT against body lice, *Pediculus humanus humanus* L. (*P. h. corporis* Deg.), and head lice [*P. h. capitis* Deg.]. Reinfestation was found to occur, and treated clothing and bedding were then left for 48 hours in closed dustbins in the sun before being returned to their owners. This prevented their being washed within 48 hours, and heat has been stated to accelerate the action of DDT. The method was completely effective. A second powdering after 7–10 days is desirable to kill recently hatched lice, but as a very concentrated effort would be needed to do this thoroughly and instructions not to shake or wash clothing are frequently ignored, it is recommended that the practicability of impregnation of clothing should be studied.

In the second paper, it is recorded that strains of rickettsiae were isolated from two of four batches each of 30–40 lice collected from infected compounds. As it was thought that *Xenopsylla cheopis* (Roths.) might be transmitting the rickettsiae, fleas of this species from uninfected giant bush rats (*Cricetomys gambianus*) and from the same hosts 17 days after injection into them of infected guineapig brain and spleen were ground and injected into three guineapigs. Fleas from uninfected hosts caused no reaction, but in some cases reactions occurred 8–10 days after injection of fleas from infected hosts. The fact that the fleas can harbour the rickettsiae is not evidence that the strains are murine since it has been repeatedly shown that rickettsiae of epidemic typhus can be transmitted through them. Bed-bugs were abundant, and in view of Neujean's claim to have found *Cimex hemipterus* F. infected with typhus during epidemics in the Belgian Congo [*R.A.E.*, B **36** 144], ten were collected from a compound where a patient was believed to have died of typhus and ground in 10 cc. physiological saline, and the supernatant fluid after slow centrifugation injected intraperitoneally into guineapigs. These showed no thermal reaction and developed no immunity. Ticks (*Rhipicephalus sanguineus* (Latr.)) collected from dogs in Jos and the neighbourhood and from dogs inoculated 17–30 days

previously with the Jos strain caused no reaction in guineapigs into which suspensions were injected, nor did *Boophilus* sp. from cattle, donkeys and sheep. The rickettsiae gave rise to orchitic reactions in early passages through guineapigs, but not in later ones, and the reactions were always mild. Sera from patients and from experimentally infected rabbits and guineapigs usually showed agglutination in higher dilutions with epidemic than with murine rickettsial suspensions. Complement fixation tests with human sera from Jos and Kaduna where a case of undetermined etiology occurred showed greater reactions with epidemic than with murine antigens.

In the third part, the clinical manifestations are described in detail. They are shown to differ in many respects from those classically associated with epidemic typhus.

SALT (R. W.). **Time as a Factor in the Freezing of undercooled Insects.**—*Canad. J. Res.* (D) **28** no. 5 pp. 285–291, 1 graph, 3 refs. Ottawa, 1950.

An account is given of laboratory experiments in which it was shown that undercooling points determined by exposure to a falling temperature gradient are not reliable as a measure of the cold-hardiness of insects. They were carried out mainly on larvae of *Cephus cinctus* Nort., and confirmed by tests on the pupae of this sawfly, the diapausing eggs of a grasshopper, overwintering larvae of a Trypetid, and overwintering and feeding Lepidopterous larvae. It was found that individual insects kept in an undercooled state at a given temperature freeze at irregular intervals, often over long periods of time. Freezing, which is fatal to most insects, is initiated by the formation of an ice-crystal nucleus, and the probability of such formation depends on the extent of undercooling (temperature), the cold-hardiness of the insect (which is a complex resulting from previous treatment) and time. For a specific degree of cold-hardiness, the probability of freezing at a fixed temperature can be expressed in units of time. Freezing can take place on a rising temperature gradient as well as on a falling one.

It is concluded that unless an overwintering population is adequately protected by its environment and a high degree of cold-hardiness, losses from freezing will take place by degrees during the entire winter. Moreover, the time factor explains a number of anomalies in the literature on winter mortality of insects. Thus, the author found that larvae of *Hypoderma lineatum* (Vill.) had undercooling points below −19°C. [−2·2°F.] and concluded that they are safe at any temperature above this [*cf. R.A.E.*, B **34** 16], but Pfadt [**37** 75] obtained frozen (and killed) larvae after eight hours at −10°C. [14°F.] and after one, four and eight hours at −15°C. [5°F.].

BUSVINE (J. R.). **Insects and Hygiene. The Biology and Control of Insect Pests of medical and domestic Importance in Britain.**—$8\frac{1}{2} \times 5\frac{1}{2}$ ins., xiv—482 pp., frontis., 57 figs., many refs. London, Methuen & Co., Ltd., 1951. Price 30*s*.

The first seven chapters of this comprehensive monograph on arthropods of medical and domestic importance in Britain are general in character. In addition to the introductory one in which notes are given on mechanical and specific transmission of diseases of man by arthropods, myiasis, poisoning, allergy, pathological obsessions with arthropods as their object, arthropods as destructive household pests, and historical aspects, they comprise accounts of the structure and classification of insects (and the classification of the Arachnida), anatomy and physiology, ecology of individual insects and insect populations, the organisation of measures for the prevention and control of infestation, mechanical

and physical control measures and insecticides. The chapter on insecticides is divided into a section on theory and one on practice. Their mode of action and factors affecting it are dealt with in the former, and typical stomach poisons, contact poisons, fumigants and repellents, the ways in which they are used and risks of toxicity and damage in the latter.

The next nine chapters deal with the bionomics, importance and control of special groups of insects, mostly of medical or sanitary importance, and one includes a section on mites and ticks. There are also two appendices. The first includes keys for the identification of the pests, and the second consists of directions for the estimation of insecticides and an alphabetical list of insecticidal substances with notes on their composition and properties.

Nicholson (H. P.), Gaines (T. B.), McWilliams (J. G.) & Vetter (M. H.). **Combined Typhus-Malaria Control residual Spray Operations with five percent DDT Emulsion.**—*Publ. Hlth Rep.* **63** no. 31 pp. 1005–1013, 7 figs., 2 refs. Washington, D.C., 1948.

Objection is often raised on account of unsightliness to the placing of patches of DDT dust along rat runways in houses for the control of fleas that may carry murine typhus, but there is no such objection to spraying with water emulsions of xylene containing DDT against Anophelines. A study was therefore begun in 1947 to test the practicability of using such sprays to leave a toxic deposit against ectoparasites of rats and to determine whether spraying against Anophelines as an anti-malaria measure and dusting for murine typhus control might be combined. Of 40 selected farm premises in Georgia with large populations of *Rattus rattus*, 25 were treated on or about 5th April and 15 left untreated as controls. The mean number of ectoparasites per rat was ascertained for rats taken before treatment began, a few days after treatment and at intervals of about five weeks thereafter. The emulsion used was prepared from a concentrate containing 35 per cent. DDT with xylene and Triton X-155 diluted to contain 5 per cent. DDT and applied at 200 mg. DDT per sq. ft. Entrances to rat burrows and harbourages were treated more heavily. In addition to the walls and ceilings of each room, spray was applied to a two-foot strip of floor adjacent to the walls and also to the attic. Outbuildings showing evidence of rat infestation were sprayed, care being taken to avoid contamination of stored fodder, and the whole of the floor was included where possible. Before spraying began, 129 rats were trapped on premises to be treated and 79 on control premises. The flea index was 11·8 on the former and 4·8 on the latter. The predominant species was *Leptopsylla segnis* (Schön.) ; *Xenopsylla cheopis* (Roths.) was scarce at this time. Mites, especially *Liponyssus bacoti* (Hirst), were numerous, and the rat louse, *Polyplax spinulosa* (Burm.), was common though not abundant.

Control of fleas was satisfactory, both initially and over a period of about four months. The average numbers of *Leptopsylla segnis* per rat were 9·6 before treatment, 0·3 in mid-April, 0·02 or less in May–August and 0·3 in October. Its numbers on control rats increased considerably in April and then fell, but were never so small as on rats from treated premises. The initially small number of *X. cheopis* was prevented from increasing on treated premises, but increased considerably on control farms. *Echidnophaga gallinacea* (Westw.) and *Rhopalopsyllus gwyni* Fox were also present but were of minor importance. The overall control of the four species achieved is shown on a graph. Before treatment, the percentages of rats bearing fleas on the control and experimental premises were 58 and 84, respectively. After spraying, the percentage from treated farms fell to less than 20, while that on control farms rose slightly. Thereafter, the difference remained approximately constant for about four months. In August–October the curves converged sharply.

Of 19,806 mites combed from the rats during the study, 98·7 per cent. were *Liponyssus bacoti*. Infestation by it on the two groups was approximately the same in March, and the treatment prevented a sharp increase that occurred on rats in the untreated premises. The duration of effective control could not be determined because of the normal seasonal reduction in numbers during summer. No significant effect on *P. spinulosa* resulted from the treatment.

The cost of the operations is discussed. Although the emulsion gave satisfactory immediate and lasting control of rat fleas, spraying alone for the control of rat ectoparasites would not always be practicable from the point of view of cost of labour. It is believed that from the standpoints both of economy and of effectiveness, a combination of spraying and dusting would be desirable, dust being used in most attics and outbuildings, and in harbourages. The direct treatment of harbourages is essential for control of *X. cheopis*.

Bushland (R. C.), Claborn (H. V.), Beckman (H. F.), Radeleff (R. D.) & Wells (R. W.). **Contamination of Meat and Milk by Chlorinated Hydrocarbon Insecticides used for Livestock Pest Control.**—*J. econ. Ent.* **43** no. 5 pp. 649–652, 7 refs. Menasha, Wis., 1950.

Three years' studies in the United States on the effects of sprays and dips of DDT, DDD (TDE [dichlorodiphenyldichloroethane]), methoxy-DDT (methoxychlor), chlordan, toxaphene, technical BHC (benzene hexachloride) and lindane [containing at least 99 per cent. γ BHC] on the meat and milk of treated animals are reviewed. Examination of sheep and goats that had received excessive dosages of the first six materials [*R.A.E.*, B **37** 235] showed that all of them were absorbed and stored in the fat in relatively large amounts. They were still present in appreciable, though reduced quantities (10–36 parts per million) after seven months, but no DDT or DDD was found in goats after 19 months. Cows sprayed with 0·5 per cent. DDT as suspensions or emulsified solutions five times at intervals of 28 days had an average of 15 p.p.m. DDT in the fat on autopsy one month after the last treatment. Calves suckled by the treated cows had an average of 25 p.p.m. DDT in the fat if they had not themselves been sprayed and 52 p.p.m. if they had. These figures are thought to represent the maximum contamination that would result from spraying for the control of *Siphona irritans* (L.). DDT and DDD were also found in the milk of treated cows [**38** 53], and the spraying of dairy barns with DDT or DDD for fly control resulted in contamination of milk unless special precautions were taken [*cf.* **39** 7, 8, 82, 85].

In a series of experiments in which cattle were sprayed 12 times at intervals of two weeks with emulsions containing 0·5 per cent. chlordan or toxaphene or enough technical BHC to give 0·025 per cent. γ isomer, the omental fat contained 4·8 p.p.m. organic chlorine before treatment. Toxaphene gave inconclusive results in one test. In others, cattle sprayed with a kerosene-base toxaphene emulsion had an average of 11 p.p.m. organic chlorine in the fat two weeks after the 12th spraying but only the normal amount after a further four weeks. When a xylene emulsion was used, the figure at both the corresponding readings was 8 p.p.m., which was probably not a significant increase. Treatment with chlordan and BHC resulted in average organic chlorine contents of 17, 6 and 5, and 26, 11 and 4 p.p.m., respectively, 2, 6 and 10 weeks after the 12th treatment. The insecticides were applied at a concentration and frequency that might be used for tick control, but the number of treatments probably exceeded any that would be applied in practice.

Cattle receiving 100 p.p.m. lindane in their food for two weeks had about 65 p.p.m. lindane in the fat. Samples of fat taken after ten weeks

on food containing 1, 10 and 100 p.p.m. lindane contained, respectively, about 2, 8 and 100 p.p.m., and samples taken two weeks after the inclusion of lindane in the food ceased showed about 2, 4 and 50 p.p.m. Milk taken periodically after dairy barns had been sprayed with emulsions and suspensions to leave a deposit of 25 mg. lindane per sq. ft. was reported free of lindane. A cow sprayed with 0·1 per cent. lindane and muzzled to prevent licking, one sprayed with the same and not muzzled and a third sprayed with 0·05 per cent. lindane and muzzled had 1·5, 2·4 and 1 p.p.m. lindane in the milk on the day after spraying. Thereafter, the concentrations fell rapidly.

YATES (W. W.) & LINDQUIST (A. W.). **Exposure of House Flies to Residues of certain Chemicals before Exposure to Residues of Pyrethrum.**—*J. econ. Ent.* **43** no. 5 pp. 653–655, 5 refs. Menasha, Wis., 1950.

The following is virtually the authors' summary. Houseflies (*Musca domestica* L.) were exposed for five minutes to a deposit of 40 mg. per sq. ft. of chemicals selected as possible synergists and then, after intervening periods of 5 minutes, 4 hours, 24 hours and 48 hours, were brought in contact with a deposit of 0·5 mg. pyrethrins per sq. ft. Of the 51 chemicals tested by this method, piperonyl butoxide, N-isobutylundecyleneamide, sesamin concentrate, piperonyl cyclonene, the ethyl ester of piperonylic acid, and n-propyl isome [a condensation product of isosafrole and n-propyl maleate (*cf. R.A.E.*, B **35** 186)], given in the decreasing order of effectiveness, were outstanding in increasing the effectiveness of pyrethrins. They accelerated knockdown and increased mortality. No visual injury or toxic symptoms were apparent in the synergist-treated flies, but apparently the synergist caused some more or less permanent effect that lowered the resistance of the flies to pyrethrum poisoning. When flies were exposed to combined deposits of 0·5 mg. pyrethrins and 0·5 mg. adjuvant per sq. ft., piperonyl butoxide, N-isobutylundecyleneamide and sesamin concentrate showed the greatest synergistic properties.

FREAR (D. E. H.), BRUCE (W. N.) & RAGSDALE (A. C.). **DDT in Milk following Barn Spraying.**—*J. econ. Ent.* **43** no. 5 pp. 656–657, 3 refs. Menasha, Wis., 1950.

An investigation into the extent of contamination of milk from cows housed and fed in barns sprayed with DDT [*cf. R.A.E.*, B **39** 81] was carried out in 1949 in four barns in Pennsylvania, three in Illinois and one in Missouri. A suspension containing 10 lb. of 50 per cent. wettable DDT powder per 100 U.S. gals. was used in Pennsylvania and one containing 40 lb. of the powder elsewhere. Dosage was adjusted to give about 200 mg. DDT per sq. ft. in Pennsylvania and Illinois. The cows were not in the barns at the time of application, and mangers, water containers, forage and salt blocks were covered with wrapping paper during spraying and for 15 minutes afterwards, except in the Missouri barn. This barn was sprayed twice. On the first occasion, the manger and water bowls were not covered but were scrubbed before the cows returned to the barn. On the second occasion, they were covered. Results of analysis of samples of milk are given. The average amounts of DDT found in the samples were 0·2 part per million on the day of spraying and 0·1, 0·3, 0 and 0 on the first, second, seventh and 14th days after spraying. With one exception (in Pennsylvania), the amount never exceeded 0·5 p.p.m. The DDT found in the milk on the day of spraying must have reached it through mechanical transfer since the cows were milked as soon as they returned to the barns.

GJULLIN (C. M.), CROSS (H. F.) & APPLEWHITE (K. H.). **Tests with DDT to control Black Fly Larvae in Alaskan Streams.**—*J. econ. Ent.* **43** no. 5 pp. 696–697, 2 refs. Menasha, Wis., 1950.

The following is based on the authors' summary. Tests during the summers of 1947 and 1948 indicated that Simuliid larvae that had hatched in the year of treatment could easily be controlled by light dosages of DDT applied to streams with hand or aeroplane equipment [*cf. R.A.E.*, B **38** 51, 88]. Early in May 1949, sprays containing 20 per cent. DDT, 40 per cent. Velsicol AR-50 and 40 per cent. fuel oil were applied from aircraft to the Naknek River and its tributaries near Naknek, Alaska, at 0·1 lb. DDT per acre, to determine the effect on overwintered larvae. The treatments caused detachment of small larvae, but had little or no effect on the large overwintered ones. Similar treatments to the same streams in late June gave complete control of new-generation larvae.

Hand applications made in the third week of May at 0·3, 0·5 and 2 parts DDT per million for 15 minutes caused only 22, 29 and 60 per cent. detachment of overwintered larvae in a stream, whereas at similar temperatures (42, 50 and 62°F.) in July and August of previous seasons, 0·4 p.p.m. was completely effective against new-generation larvae.

The seasonal difference in the effectiveness of the same treatments indicates that overwintering Simuliid larvae are less susceptible to DDT than new-generation larvae, and tests are needed to determine whether late autumn may not be the best time for treatment against potential overwintering populations.

GOUCK (H. K.) & FLUNO (J. A.). **Field Tests on Control of American Dog Tick in Massachusetts.**—*J. econ. Ent.* **43** no. 5 pp. 698–701, 5 refs. Menasha, Wis., 1950.

The following is based on the authors' summary. Field tests were carried out in 1948 and 1949 in south-eastern Massachusetts (including some in Martha's Vineyard in 1948) to compare the effectiveness of various insecticides in sprays against *Dermacentor variabilis* (Say) with that of DDT [*R.A.E.*, B **37** 76, 204, etc.]. Extensive observations were also made on the effectiveness against the tick of applications of DDT to large areas by aeroplane for the control of the gipsy moth, *Lymantria* (*Porthetria*) *dispar* (L.).

In comparative tests on small plots, DDT and dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] were the most effective materials, 1 lb. per acre of either giving over 90 per cent. control of ticks for 5–6 weeks. DDT at 2·5 lb. per acre gave effective control for at least 8 weeks. Toxaphene and chlordan were slightly less effective than DDT at both 1 and 2·5 lb. per acre. Parathion at 0·5 lb. was relatively ineffective after the first week. Applications of 1 lb. per acre DDT, toxaphene and chlordan in 1 U.S. gal. oil (12 per cent. solutions) gave about as good control as the same dosage applied in 15 U.S. gals. emulsion. Dieldrin was tested in oil solution only, and parathion in emulsion only.

Treatment by aeroplane gave 85–97 per cent. control of ticks for 4 weeks when 1 lb. DDT per acre was dispersed in oil solution. Applications at 0·25–0·5 lb. per acre varied considerably in effectiveness, but were generally much less effective than 1 lb. An application at 1 lb. DDT per acre in 1 U.S. gal. oil by helicopter operating under optimum conditions gave about as good results as the same dosage applied on small plots with ground equipment.

GOULDING jr. (R. L.) & DEONIER (C. C.). **Observations on the Control and Ecology of Black Flies in Pennsylvania.**—*J. econ. Ent.* **43** no. 5 pp. 702–704. Menasha, Wis., 1950.

A study of the effect on Simuliid populations of DDT sprays applied by aeroplane to large areas for the control of the gipsy moth [*Lymantria dispar*

(L.)] was made in Pennsylvania in the spring and summer of 1948. A 12 per cent. solution of DDT in kerosene and xylene was applied at 1 lb. DDT per acre in May or June. Large streams and open bodies of water were avoided, or treated only lightly, to prevent possible damage to fish. Sampling methods are described. Larvae were completely controlled at 34 stations in 15 streams out of a total of 35 stations in 16 streams. The remaining station was on a narrow strip of land between two lakes and probably received only a very light treatment. It had 1·1 larvae per unit (stone, leaf or blade of grass) 60 days after spraying, compared with 169 per sq. inch before spraying. Spraying appeared to have no lasting effect, as larvae transferred from an untreated to a treated station immediately after the oil on the water had disappeared survived for a week. Treatment of 0·25 mile of the head-waters of a stream caused detachment of larvae 0·75 mile below the area of direct treatment.

Pupae were not affected by the spray. Adults were present in the treated area immediately after spraying, but were not seen one week later, although many had emerged from the pupae present at the time of treatment. Oviposition was not observed in the treated areas. It is inferred that enough DDT remained on emergent vegetation or stream banks to kill the emerging adults.

The most numerous of the seven species found in the area were *Simulium venustum* Say, *S. vittatum* Zett. and *S.* (*Cnephia*) *dacotense* (D. & S.). The larvae were most abundant immediately below the outlets of lakes, ponds and bogs. Breeding was observed in streams with rates of flow varying from less than 1 ft. to more than 4 ft. per second. Larvae were found attached to stones, wood, leaves, grass blades, glass and trash, and eggs to grass, leaves and paper at or just below the surface, but rarely to rocks.

March (R. B.) & Lewallen (L. L.). **A Comparison of DDT-resistant and non-resistant House Flies.**—*J. econ. Ent.* **43** no. 5 pp. 721–722, 4 refs. Menasha, Wis., 1950.

Wiesmann reported morphological and physiological differences between a DDT-resistant strain of house-flies [*Musca domestica* L.] from Sweden and a non-resistant strain from Switzerland [*R.A.E.*, B **37** 217]. A study was therefore undertaken to determine whether similar differences existed between the resistant Bellflower strain from southern California and a non-resistant laboratory strain with which it was compared in toxicological studies [**38** 156].

No differences in the gross morphology of the two strains were found. Microscopic comparison showed that in general the tarsi of the Bellflower strain tended to be slightly shorter than those of the laboratory strain, the first tarsal segment of the midleg of the females being the only exception. The tarsal widths were more variable. Differences in the dimensions of the tarsal segments of the two strains were statistically valid in most cases, though less striking than those found by Wiesmann. Differences between the average range in thickness of cuticle of the first tarsal segments of ten forelegs of each strain were not significant. When the strains were reared under identical conditions at 80°F. and 40 per cent. relative humidity, no significant difference was found in length of life, weight of female flies or, except in one instance, susceptibility to heat and cold. Thus, thickness of cuticle and general vigour are apparently not concerned in the more than 300-fold increase in resistance to DDT shown by the Bellflower strain, nor were the differences in the dimensions of the tarsal segments large or uniform enough to indicate that they contributed to it.

Fox (I.). **The Brown Dog Tick on Rats in Puerto Rico.**—*J. econ. Ent.* **43** no. 5 pp. 722–723, 3 refs. Menasha, Wis., 1950.

Since it has been shown that nymphs of *Rhipicephalus sanguineus* (Latr.) may engorge on rats in nature [*R.A.E.*, B **37** 116], it is possible that this tick

might transmit murine typhus. Between January 1946 and March 1949, 1,326 rats collected from San Juan, Porto Rico, where both the tick and murine typhus commonly occur, were examined for infestation. Of 938 examined from a poor residential locality, two of 129 individuals of *Rattus rattus* and 28 of 809 of *R. norvegicus* yielded 8 larvae, 9 nymphs and 18 adults, of which four adults and one nymph showed evidence of engorgement. Of 388 rats from restaurants etc. in a business locality, only two of 354 individuals of *R. rattus* were infested, one with an unengorged larva and one with an unengorged adult. It is concluded that in view of this low degree of infestation, it is unlikely that *R. sanguineus* could play a significant part in the transmission of murine typhus in Porto Rico.

CLABORN (H. V.), BECKMAN (H. F.) & WELLS (R. W.). **Contamination of Milk from DDT Sprays applied to Dairy Barns.**—*J. econ. Ent.* **43** no. 5 pp. 723–724, 1 ref. Menasha, Wis., 1950.

The following is almost entirely the authors' summary. A study was made in 1949 to determine the source of contamination of milk of unsprayed cows housed in dairy barns that had been sprayed with 2·5 per cent. DDT as a wettable-powder suspension. Three experiments showed that the insecticide was actually excreted in the milk when the possibility of contamination through mishandling of the milk or milking equipment was excluded, that no contamination resulted from inhalation of the insecticide by the cows, and that the spray deposits left on the feed trough resulted in the excretion of the insecticide in the milk even though reasonable care was taken not to wet the trough directly with spray. Contamination of milk did not occur when troughs were completely covered during the spraying or washed after spraying [*cf. R.A.E.*, B **39** 82].

GERSDORFF (W. A.), NELSON (R. H.) & MITLIN (N.). **Chlorinated Hydrocarbons. The relative Toxicity of Heptachlor, Aldrin and Dieldrin to House Flies when applied as Space Sprays using Campbell Turntable Method.**—*Soap & sanit. Chem.* **26** no. 4 pp. 137, 139, 1 ref. New York, N.Y., 1950.

Experiments on the toxicity of heptachlor [1 (or 3a),4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7-endomethanoindene], aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] and dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] as space sprays against *Musca domestica* L. were described by Kearns, Weinman & Decker [*R.A.E.*, B **38** 55]. Similar studies made by the Campbell turntable method **26** 246] are reported in this paper. The materials were of technical grade but were white crystalline solids of a high degree of purity, with boiling points of 89–91, 95–98 and 173°C., respectively. Chlordan and pyrethrum were used as standards for comparison. Sprays were prepared by dissolving the materials in refined kerosene, the mean concentrations needed to give 50 per cent. mortality in a day were determined and the results were examined statistically. Heptachlor and aldrin were about four times as toxic and dieldrin 5·9 times as toxic as technical chlordan. They were, respectively, 28, 22–25 and 32 times as toxic as a 20 per cent. pyrethrum concentrate. Two populations of flies that were similar in their susceptibility to chlordan varied in susceptibility to pyrethrins, indicating that a better respresentation of the relative toxicities of chlorinated hydrocarbons is obtained if they are compared among themselves. Purified crystalline chlordan was only about two-thirds as toxic as technical chlordan. None of the sprays made with the chlorinated compounds caused appreciable knockdown.

Watt (J.) & Lindsay (D. R.). **Diarrheal Disease Control Studies. I. Effect of Fly Control in a high Morbidity Area.**—*Publ. Hlth Rep.* **63** no. 41 pp. 1319–1334, 5 graphs, 1 map, 2 refs. Washington, D.C., 1948.

The effect of fly control on the incidence of diarrhoeal diseases was investigated between January 1946 and February 1948 in nine small towns of southern Texas, where diseases of this type are common. The prevalence of infection with *Shigella* and *Salmonella* was measured by making rectal swab cultures of a representative sample of Latin-American children under ten. Families in the chosen blocks were also questioned monthly on the incidence of diarrhoeal disease and the regular reported mortality from this type of disease was noted. Relative fly abundance in treated and untreated blocks was determined with Scudder's fly grill [*R.A.E.*, B **38** 158], beginning with April 1946. Treatment was with DDT sprays to leave a toxic residue, and it was repeated whenever the two highest grill counts in a block averaged ten in the remainder of 1946, and when a single count reached seven after January 1947. Some blocks needed treatment every week or even twice weekly for short periods. The effect of treatment on the fly populations is briefly indicated. It is stated that in general, house-flies (*Musca domestica* L.) accounted for the greatest seasonal variations, but details of the populations of different species are to be given in a further paper. There were no indications of the presence of DDT-resistant strains. Results as regards the infections are given in some detail. A significant reduction in the amount of infection, disease and death resulted from the degree of control established. The effect on *Shigella* infections was greater than on infections with the *Salmonella* group of organisms.

Williams (R. W.). **Studies on the Life Cycle of** *Litomosoides carinii*, **Filariid Parasite of the Cotton Rat,** *Sigmodon hispidus litoralis*.—*J. Parasit.* **34** no. 1 pp. 24–43, 2 pls., 51 refs. Lancaster, Pa., 1948.

The following is based on the author's summary. A survey of the literature indicates that only about 15 of the hundreds of Filariid parasites of animals other than man have been shown to develop to presumably infective stages in arthropods, and whether these arthropods serve as vectors in nature is not known. Transmission experiments have been carried out with five of the 15 species, and three of the attempts were probably successful. However, some question exists concerning two of them, and though a few microfilariae were found after transmission in the third [*R.A.E.*, B **32** 98], no adult worms were recovered. Investigators of filariasis were until recently handicapped through lack of a filarial worm that could be quickly and easily transmitted from one satisfactory laboratory animal to another. However, since there was evidence to suggest that *Litomosoides carinii*, a parasite of various subspecies of the cotton rat (*Sigmodon hispidus*) in the southern United States, developed rapidly within this host, the epidemiology of filariasis in the cotton rat was studied, particularly with a view to finding an arthropod vector [**37** 132, *cf.* also **37** 139 ; **38** 74, 191].

The incidence of the disease in cotton rats (*S. h. litoralis*) from Florida was found to be about 43 per cent. The infection occurred throughout the year and in scattered foci. The prepatent period was found to be sometimes 60 days or less but was usually between 70 and 80 days for animals infected in the laboratory [*cf.* **38** 191]. The adult worms may live for 60 weeks or more in the pleural cavity, and production of microfilariae is highest between the 17th and 20th week. Microfilariae are still found in the circulating blood of infected animals some 50–60 days after the death of the adult worms. The sheathed

embryos can evidently burrow between and into muscle fibres. The microfilariae are thought to enter the blood stream from the pleural cavity through the lungs and possibly the heart [*cf.* **37** 140].

In the search for possible vectors, four species of *Aëdes*, *Culex pipiens* L., *Mansonia perturbans* (Wlk.), *Tabanus* spp., *Chrysops* sp., *Culicoides* spp., *Cimex lectularius* L., *Polyplax spinulosa* (Burm.), *Ixodes scapularis* Say, *Rhopalopsyllus gwyni* Fox and *Liponyssus bacoti* (Hirst) were studied. The microfilariae appeared to be digested or evaculated after ingestion in all but *L. bacoti*, in which developmental forms were found. About 14 per cent. of *L. bacoti* feeding on infected cotton rats were found to contain developing filariae. Thirty or more days were needed for complete development within the mite [*cf.* **39** 22]. Of some 4,093 mites taken at random from a colony that had developed for more than 30 days, 14·8 per cent. contained infective forms. An average of 4·94 infective worms per mite was found in 100 infected mites examined. Development took place within the haemocoele. The infective forms were 800–1,000 μ long and 15·6 μ wide.

Every attempted transmission was successful when cotton rats or white mice were placed in contact with infected mites, but no experimental animals became infected as a result of ingesting infected mites. This and the fact that two days after mites containing infective worms were placed on rats, some were recovered that were free of worms, strongly suggest that *Litomosoides carinii* invades a new rodent host through the skin rather than by ingestion. Although white rats were infected and microfilariae produced, the adult worms appear to live a relatively short time in this unnatural host [*cf.* **37** 140].

GASSNER (F. X.) & JAMES (M. T.). **The Biology and Control of the Fox Maggot, *Wohlfahrtia opaca* (Coq.).**—*J. Parasit.* **34** no. 1 pp. 44–50, 9 figs., 23 refs. Lancaster, Pa., 1948.

Heavy losses to fur farmers result from infestation of young foxes and mink by *Wohlfahrtia vigil* (Wlk.) in the east of the United States and Canada and by *W. opaca* (Coq.) in the west of those countries [*cf. R.A.E.*, B **39** 35, etc.], where it is widespread. The habits of *W. opaca* are in general similar to those of *W. vigil* [**20** 47 ; **25** 10, etc.]. The adults have been taken from late May to late September, but the earlier presence of larvae indicates that they may sometimes be active by the end of March. They are attracted to flowers and sweet substances, but not to carrion. They feed in direct sunlight, but females are not deterred from larviposition by the darkness of the kennels. The larvae are obligate parasites, but it was observed that those that have reached the third instar when the host dies can mature in the carcass. Of 22 third-instar larvae that were obtained from fox cubs in Colorado and entered moist sand on 15th and 17th May 1946, 21 gave rise to adults. These emerged from 7th to 12th June, and one pair mated on 15th June. Six out of nine larvae that hatched from eggs squeezed from the dead body of a trapped female fly and were placed on the shaved skin of a rabbit penetrated the skin, taking 6–11 minutes to do so. Infestation did not become established. Penetration may have been unusually difficult because the maggots were obtained in an abnormal manner and were newly hatched and the rabbit was older than animals usually are when attacked. As a rule, foxes and mink are less than four weeks old when infested, but adult animals are attacked when weakened by disease. Recovery is usually rapid after timely removal of larvae, but if infestation is heavy or allowed to continue, death results. Every young animal on a ranch should be thoroughly examined during the fly season. Trials in 1945 and 1946 indicated that dusting with 3–10 per cent. DDT in talc gave a considerable degree of protection to fox pups.

Knipling (E. F.), Bushland (R. C.), Babers (F. H.), Culpepper (G. H.) & Raun (E. S.). **Evaluation of selected Insecticides and Drugs as chemotherapeutic Agents against external Bloodsucking Parasites.**—*J. Parasit.* **34** no. 1 pp. 55–70, 13 refs. Lancaster, Pa., 1948.

The following is almost entirely the authors' summary. Certain insecticides and drugs were administered internally to rabbits to determine their value as chemotherapeutic agents against body lice (*Pediculus humanus humanus* L. (*P. h. corporis* Deg.)) and mosquitos (*Aëdes aegypti* (L.)) that were subsequently allowed to take blood-meals on the treated hosts [*cf. R.A.E.*, B **32** 198 ; **36** 184]. Several chemicals were evaluated also against the ear mite (*Psoroptes cuniculi* (Delafond)) and against the lone star tick (*Amblyomma americanum* (L.)).

In the initial tests against lice and mosquitos, the chemicals were usually administered orally to the rabbit at a dosage of 300 mg. per kg. body weight. In all, 33 chemicals were tested against lice and 31 against mosquitos. Further tests at lower dosages were made with those that caused complete kill. Observations were made on the effect of nine chemicals on the mite and of two on the tick.

Chemicals that had a definite toxic action at 300 mg. per kg. or less against lice that were allowed one blood-meal on the treated host were γ BHC (benzene hexachloride), chlordan, chlorinated camphene [toxaphene], dicumarol (3,3′-methylene-bis-4-hydroxycoumarin), powdered sabadilla seed and several derivatives of 1,3-indandione. Several of the chemicals proved fatal to the host at 300 mg. per kg.

When mosquitos were allowed to engorge on the treated rabbits, the chemicals that showed some action at 300 mg. per kg. or less were γ BHC, chlordan, chloromethyl *p*-chlorophenyl sulphone, dicumarol and four derivatives of 1,3-indandione. The only one that caused complete mortality of mosquitos at the initial dosage was γ BHC. In subsequent tests in which it was administered in maize oil or in crystalline form at 100 and 25 mg. per kg., complete kill of mosquitos was obtained for several days. It was appreciably but inconsistently toxic to the hosts. A dosage of 5 mg. per kg. caused 93 per cent. mortality of mosquitos fed 24 hours after it was administered to the host.

The only chemicals that caused complete mortality of lice when administered to the host at the rate of 300 mg. per kg. were some of the indandione derivatives, and most of the rabbits treated with them died within a week. The most effective. 2-pivalyl-1,3-indandione, was tested extensively at various dosages and by different methods of administration. Oral dosage of 5–100 mg. per kg. caused complete mortality of lice allowed a single blood-meal, and the duration of complete kill varied from 3 to 8 days, with partial kill for several days thereafter. There was little relation between the dosage and the duration of the toxic effect. An oral dosage of 2·5 mg. per kg. caused complete or nearly complete kill of lice allowed one blood-meal, whereas 1 mg. per kg. caused mortalities ranging from 18 to 30 per cent. of lice on three rabbits. Subcutaneous, intramuscular and intravenous injections at 2·5 mg. per kg. produced results comparable with those obtained with oral administrations at the same dosage. Some kill of lice was obtained also when the chemical was administered (in solution) by inunction through the unbroken skin, but results were erratic. There was a definite accumulation of the toxic agent in the blood of the host when the chemical was administered orally each day for several days. There was likewise a cumulative effect in lice allowed repeated blood-meals on rabbits receiving daily doses. A rabbit that received 0·1 mg. per kg. daily for 19 days in food caused complete or nearly complete mortality of female lice in different lots allowed six blood-meals each after one week and during the rest of the time the animal was receiving treated food. The toxic agent persisted in the blood of the rabbit for several weeks after it ceased to receive treated food. Female

lice showed a higher mortality when they engorged on treated hosts than did the males, but this is explained by the fact that, with reference to body weight, the females consume about 2·5 times as much blood as do the males. Rabbits receiving 5 mg. or less of the chemical per kg. in single doses and those receiving 0·1 and 0·25 mg. per kg. per day in food for 19 days suffered no apparent injury, and continued to gain weight.

Psoroptes cuniculi was killed by single doses of γ BHC given to hosts at 100–300 mg. per kg. Dosages of 50 mg. per kg. caused only partial kill. Larvae and nymphs of *A. americanum* were not affected when allowed to engorge on a rabbit that had received an oral dosage of 25 mg. γ BHC per kg. ; 5 mg. per kg. 2-pivalyl-1,3-indandione also proved ineffective, but 25 mg. killed all larvae and most nymphs.

There is little relation between the effectiveness of some of the chemicals as contact insecticides against lice and mosquitos and their value as chemotherapeutic agents. As contact insecticides against lice, DDT, BHC, chlordan and toxaphene are about as effective as 2-pivalyl-1,3-indandione [*cf.* **37** 203], but when administered to rabbits as chemotherapeutic agents, the last material was 300 times as toxic as the most effective of the others. Chemotherapeutic agents for blood-sucking insects apparently show high specificity ; γ BHC was much more effective against mosquitos than against lice, whereas the reverse was true of 2-pivalyl-1,3-indandione.

Farrell (C. E.) & Wharton (G. W.). **A successful Method for shipping larval Trombiculids (Chiggers).**—*J. Parasit.* **34** no. 1 p. 71. Lancaster, Pa., 1948.

To convey Trombiculid larvae by the method described, the collector is given special vials and labels packed in excelsior or cotton batting in pre-addressed paraffin-sprayed screw-top cartons. He puts the mites from each host in a separate vial, attaches a label and mails the vials in the carton as soon as possible. The vials are prepared from clean 25 × 15 mm. shell vials with new, uncontaminated corks free of pits and imperfections. The vials are lined with a mixture of plaster of paris and activated charcoal (90 : 10 parts by weight) moistened with distilled water. This maintains a satisfactory humidity for the mites. New vials and corks are not autoclaved, but any that are prepared for re-use are autoclaved at 15 lb. per sq. in. for 5 mins. No parts of host animals or other organic débris must be placed in the vials. On receipt in the laboratory, the vials and corks are examined for mites with a dissecting microscope. The method has been used successfully for over 70 consignments, whereas mites sent in plain glass tubes all died in transit. If a drop of distilled water is added occasionally, the vials make good containers in which engorged larvae will transform into nymphs.

Scott (J. A.). **An Apparatus for removing Tropical Rat Mites from large Quantities of Bedding Materials.**—*J. Parasit.* **34** no. 2 pp. 132–133, 1 fig., 2 refs. Lancaster, Pa., 1948.

A description is given of an apparatus designed to extract in one working day several thousand adults of *Liponyssus bacoti* (Hirst) and the larger number of accompanying nymphs from some 4,000 cc. wood shavings and the same volume of hay, forming the bedding of the host on which the mites are reared [*R.A.E.*, B **38** 211–212]. The bedding is spread in a layer in an open trough of galvanised iron surrounded by a moat of water, and the mites are driven out of it by heat ; the principle is that of Bertram's apparatus [**37** 140], but trouble due to condensation in a closed system is avoided. The heat is applied from a 250-watt infra-red bulb with a reflector-coated back moving over the trough

at the rate of 0·5 inch per hour, which heats a one-inch layer of sawdust or a four-inch layer of hay. As it may cause mites to drop off pieces of hay after the metal bottom of the trough has become hot enough to kill them, the bottom was lined with asbestos-cement composition board. If the layer of sawdust is more than an inch thick, an auxiliary heater can be hung from the lamp carriage beneath the trough behind the centre of the lamp to heat the sawdust from beneath. When the mites are not too numerous, they can be removed from the inner top edge of the trough by means of a suction bottle, and those that fall into the water can be recovered with a camel's-hair brush. If they are numerous, a device is put into operation by which the water in the moat is periodically flushed into an overflow tube, the end of which is covered with bolting silk on which the mites are stranded. When the silk becomes covered with mites, the tube is replaced by another, dried of visible moisture and stored at about 5°C. [41°F.] until the mites are needed.

KOHLS (G. M.). *Haemaphysalis ratti*, **a new Species of Tick from Rats in New Guinea and** *Haemaphysalis krijgsmani*, **new Name for** *Haemaphysalis novae-guineae* **Krijgsman and Ponto, 1932, pre-occupied.**—*J. Parasit.* **34** no. 2 pp. 154–157, 2 figs., 3 refs. Lancaster, Pa., 1948.

The adults of both sexes of *Haemaphysalis ratti*, sp.n., are described from numerous individuals taken from rats (*Rattus* spp.) in the Dobodura area of New Guinea in 1943 and 1944. *H. krijgsmani*, n.n., is proposed for *H. novae-guineae* Krijgsman & Ponto 1932, which is pre-occupied [but for which the new name *H. meraukensis* was proposed in 1944 by F. H. Taylor (*Proc. Linn. Soc. N.S.W.* **69** p. 187)].

GREGSON (J. D.). **Notes on the Occurrence of** *Ornithodoros hermsi* **in British Columbia, and its probable Relation to Relapsing Fever. Argasidae, Ixodoidea.**—*Proc. ent. Soc. B.C.* **45** pp. 15–16, 5 refs. Kamloops, B.C., 1949.

In 1948, *Ornithodoros hermsi* Wheeler was taken in a house at Summerland, British Columbia, where it attacked one of the occupants on several occasions while she was in bed and was then found in some numbers in a bird's nest in the eaves. It is a vector of relapsing fever in the western United States [*cf. R.A.E.*, B **35** 201] and may have been responsible for cases of the disease that occurred in British Columbia in 1930, 1932 [**21** 262] and 1937. Although an Argasid tick was then suspected as the vector, none was found.

CURTIS (L. C.). **The Effect of DDT Emulsions on Trout Fry.**—*Proc. ent. Soc. B.C.* **45** pp. 31–32. Kamloops, B.C., 1949.

Following an experiment at Kamloops, British Columbia, in which Simuliid larvae in running water were controlled by treatment with a solution of DDT, Triton X-100 and xylene (10 : 10 : 80) applied at a rate that gave a dilution of one part DDT per 20 million parts water, tests were carried out to observe the effects of the treatment on trout fry. The results showed that the fish could withstand a dosage nearly four times as strong without harmful effects and one nearly eight times as strong with only slight mortality. A heavy concentration of xylene and Triton X-100 without DDT caused immediate distress, which was relieved by the prompt return of clear water conditions. DDT caused poisoning at higher concentrations, but its action was slower than that of xylene.

KETTLE (D. S.). **The Growth of *Anopheles sergenti* Theobald (Diptera, Culicidae), with special Reference to the Growth of the Anal Papillae in varying Salinities.**—*Ann. trop. Med. Parasit.* **42** no. 1 pp. 5–29, 15 figs., 26 refs. Liverpool, 1948.

The following is almost entirely based on the author's introduction and summary. In the course of a malaria survey in the Jordan Valley, it was noticed that larvae of *Anopheles multicolor* Camb. could be separated from those of *A. sergenti* (Theo.) and *A. superpictus* Grassi by the length of the anal papillae. *A. multicolor* had small rounded papillae almost as broad as they were long, whilst the other two species had papillae many times longer than they were broad. Later, in the Nile Delta, it was found that larvae of *A. multicolor* and *A. sergenti* could be separated from those of *A. coustani* Lav. and *A. pharoensis* Theo. by the same character. In the last two species, the papillae were lanceolate like those of *A. sergenti*, but they were proportionately very much longer. The difference held good for larvae collected from a number of natural breeding places of different salinities.

Various workers have used the length of the anal papillae as a diagnostic character in mosquito larvae, although it has long been recognised that the papillae of larvae reared in salt water are much smaller than those of larvae reared in fresh water [*R.A.E.*, B **10** 128 ; **21** 53, 74 ; **27** 38, 55]. As the value of a character for identification depends on its constancy, it was desired to investigate in the laboratory the effect of increasing salinity on the length of the dorsal anal papillae of the four Egyptian Anophelines concerned and to correlate this change with the range of salinity in which the larvae occur naturally, but time permitted only *A. sergenti* to be studied. In view of the importance of the growth-rate of an organ when its size is used as a specific character, experiments were begun to ascertain whether the anal papillae grow during an instar, and if so, whether their growth-rate is the same as that of any other part of the body.

Measurements were taken on 125 larvae for each of the four instars. Attention is drawn to a method of calculating accurately the growth coefficient and its standard error. The seven measurements made on each larva were the length and breadth of head, thorax and second abdominal segment and the length of the dorsal anal papillae. The head was found to show discontinuous growth with a large increase in size at each ecdysis. The mean head breadths appeared to obey Dyar's law with a ratio of increase of 1·524. However, it is also demonstrated that head size may equally be regarded as controlled by a growth partition coefficient, and it is suggested that Dyar's law is merely a special case of this more general conception. The over-all growth coefficient between the breadth of the head and the breadth of the thorax was 1·0. The thorax, growing continuously throughout larval life, underwent no sudden change at ecdysis, but its growth was heterogonic, since its length increased more rapidly than its breadth (growth coefficient 1·09 compared with 1·0). The second abdominal segment grew continuously throughout larval life, the rates of growth of its breadth and length being the same (growth coefficient 1·03) and differing significantly from those of the length and breadth of the thorax. The dorsal anal papillae showed a mixed pattern of growth, since they not only grew steadily, though slowly, during an instar, but also increased suddenly at ecdysis. The intra-instar growth-rate was low (coefficient about 0·6) and variable from instar to instar, but the over-all growth-rate (1·03) was of the same order as that of the second abdominal segment. It is suggested that the length of the dorsal anal papillae at ecdysis is controlled by a growth partition coefficient. From the intra-instar growth-rates of the length of the dorsal anal papillae of fourth-instar larvae reared in distilled water, tap-water (0·006 per cent. sodium chloride) and 0·1, 0·25, 0·5, 0·75, 1 and 1·1 per cent. sodium chloride, it is shown that these bear no relation to the lengths of the anal

papillae. The intra-instar growth-rate was lowest when the anal papillae were longest. It is suggested that the variation in the lengths of the anal papillae of larvae reared in different salinities is determined by the same mechanism as that which controls the chloride content of the haemolymph.

NASH (T. A. M.). **A Note on the Effect of high Temperature on the pupal Stage of *Glossina* in Relation to the Transmission-rate of Trypanosomes.**—*Ann. trop. Med. Parasit.* **42** no. 1 pp. 30–32, 6 refs. Liverpool, 1948.

A brief account is given of observations on the temperature of the soils in which pupæ of *Glossina morsitans submorsitans* Newst., are found at Gadau, Nigeria. This is near the hot, dry, northern limit of the fly's range, and even in the centre of a forest island, shade temperatures of 106°F. were recorded at four feet above the ground. Pupae were numerous in the dry season in soils with mean monthly temperatures (average of the mean monthly maximum and minimum readings 1·5 ins. below the surface of the soil) ranging from 69 to 82°F., but few, if any, were seen where the mean temperature was over 82°F. As Burtt, in his work on *G. m. morsitans* Westw. [*R.A.E.*, B **37** 135; **38** 47], incubated pupae at 86°F., the author considers it probable that he was using a temperature that would never occur in the pupal environment in nature. Nevertheless, the suggestion that high temperatures in the pupal environment are correlated with high transmissibility rates of trypanosomes among the emergent flies is important. Recordings in the dry season in the breeding ground of *G. palpalis* (R.-D.) near Kaduna showed that the greatest difference between temperatures at depths of 0·5 and 1·5 ins. was only 2·5°F. This is taken as an indication that a depth of 1·5 ins. was not excessive. It is suggested that Burtt's work should be repeated, comparing the transmissibility rate amongst *G. morsitans* bred from pupae incubated at 68 and at 82°F. As this is the temperature range occurring in the breeding grounds of *G. morsitans submorsitans*, and the typical form and this subspecies are physiologically similar [**25** 161], the results should hold good for the species as a whole. The assumption of increased transmission by flies that emerge from pupae incubated at high temperatures supports the tentative conclusion that, within the savannah zone of West Africa, most sleeping sickness, which is carried by *G. palpalis* and *G. tachinoides* Westw., is transmitted in the late dry season [*cf.* **32** 134]. Near the northern limit of *G. palpalis*, the tsetse population moves to the neighbourhood of permanent pools as the streams dry up, and concentration is complete at the end of the dry season. The surviving flies remain beside the pools for some months until the rains are again well advanced. The villages are often near the pools, so that contact between man and fly is very close. In normal and mild years, the adult flies live long enough in hot weather to allow trypanosomes to reach the salivary glands and to leave a further long period during which they can be transmitted. As females live much longer than males, they are potentially the more dangerous. Only in exceptionally dry seasons, might length of life be inadequate for transmission. Should it be confirmed that transmission is considerable only at the end of the dry season, it might be possible to reduce the lengths of clearings of riverine vegetation on either side of water holes and fords, as they are at present designed to prevent tsetse from reaching these places at any season and clearings are crossed much more readily in the rains.

MACFIE (J. W. S.). **Some Species of *Culicoides* (Diptera, Ceratopogonidae) from the State of Chiapas, Mexico.**—*Ann. trop. Med. Parasit.* **42** no. 1 pp. 67–87, 10 figs. Liverpool, 1948.

Some twenty thousand Ceratopogonids were collected at night by means of a light-trap during a survey of onchocercosis [due to *Onchocerca volvulus*

(*caecutiens*)] made by A. Dampf in the State of Chiapas, Mexico, in the wet season (May–July) of 1935 [*R.A.E.*, B **25** 57]. Those of the genus *Culicoides* were at that time the worst pests. They were numerous and bit viciously. Smaller collections of Ceratopogonids in the same region were made by J. Parra in August 1935 and by R. Nettel in June 1938. An examination by the author of 3,335 specimens of *Culicoides* from these collections, showed that over 97 per cent. belonged to a species here called *C. guttatus* (Coq.). The author points out that this species is variable and considers that *C. filariferus* Hoffman and *C. diabolicus* Hoffman [*cf.* **33** 146–147, etc.] are conspecific with it, as he knows no characters by which they may be separated. The other specimens comprised 15 species, for which collection data are given ; ten are described as new, and notes are given on the morphology and identity of some of the others. One new species from British Guiana is also described, and a key, based mainly on wing characters, is given to the females of the members of the genus likely to be found in the Caribbean area.

Mayer (K.) & Strenzke (K.). **Versuche mit Gix zur Bekämpfung von Fliegen und Mücken.** [Experiments with Gix for the Control of Flies and Mosquitos.] —*Anz. Schädlingsk.* **21** pt. 5 pp. 74–76, 2 refs. Berlin, 1948.

A survey is given of the results of experiments carried out in 1942–44 to test the value against mosquitos and flies of Gix (a preparation of fluoro-DDT), used chiefly in the form of an emulsified solution. Some of the information has been noticed from a shorter report [*cf. R.A.E.*, B **36** 159, 160, 161]. In laboratory tests, Gix was very effective against mosquitos (*Anopheles maculipennis* Mg., *Aëdes aegypti* (L.) and *Culex pipiens* L.), *Blatta orientalis* L. and *Ctenocephalides* (*Ctenocephalus*) sp., less effective against flies (*Musca domestica* L., *Stomoxys calcitrans* (L.), *Drosophila* and *Fannia* sp.), and ineffective against *Calandra granaria* (L.). In field tests, in some of which it was used in tents, it gave good control of various Diptera, including mosquitos and *Phlebotomus*, and of some other arthropods. When mosquitos and flies crawled on a surface treated with Gix, *Anopheles* died after contact for only 10–11 seconds and flies were affected by contact for 15 seconds and died 2–11 hours later. When placed in closed containers and separated by a gauze partition from impregnated fabric, flies became fatally affected in six hours. Spraying a room with a 3 per cent. emulsion at the rate of 1 fl. oz. per 1,000 cu. ft. gave complete knockdown of Muscids and Drosophilids in an hour and complete mortality in 17 hours ; a rate of 2 fl. oz. is recommended for practical use.

The toxicity and persistence of spray deposits were reduced if the treated surface absorbed the spray and if the temperature to which the deposit was exposed was high. Thus deposits from an emulsified solution were more effective on thin sheets of cellulose than on cellulose blocks, on glass plates than on wood, and on glass plates kept for 44 hours at 8·5°C. [47·3°F.] than on those kept at 20°C. [68°F.]. The addition of milk of lime hindered the penetration of the emulsions into porous surfaces, and it also reduced vaporisation since glass plates treated with a 0·1 per cent. emulsion of Gix at the rate of about 0·33 fl. oz. per sq. ft. lost their toxic action in three months, whereas it remained unchanged when milk of lime had been added in the proportion of 1 : 6. In the case of textiles, absorptivity is of less importance, since the legs of small insects can penetrate the weave. Thus the toxic action of tent cloth treated with a 20 per cent. emulsion at the rate of about 1 fl. oz. per sq. ft. was unchanged after five months storage.

In field tests, lime washes incorporating 1, 0·5 and 0·1 per cent. emulsions of Gix and applied with a brush in animal quarters near Berlin remained effective for 7, 4 and 2 weeks, respectively, and in the Mediterranean region, a lime wash incorporating a 1 per cent. Gix emulsion similarly applied retained its toxicity for 7–10 days on stone walls and 3–4 days on wooden walls.

Comparative tests with flies and mosquitos showed that Gesarol (a DDT preparation) acts more slowly than Gix, but retains its toxicity for longer and at higher temperatures. In experiments against *Anopheles* larvae, Gesarol and Gix emulsions were both less effective than paris green, and dust mixtures were still less so.

GARNHAM (P. C. C.), WILSON (D. B.) & WILSON (M. E.). **Malaria in Kigezi, Uganda.**—*J. trop. Med. Hyg.* **51** no. 8 pp. 156–159, 2 refs. London, 1948.

A very high spleen rate having been observed amongst all age-groups of the population of Kigezi, Uganda, in September 1946, a second visit to the area was made in January 1947 to study this in relation to the recent discovery that *Anopheles christyi* (Newst. & Cart.) is a local vector of malaria in the valleys [*R.A.E.*, B **37** 163]. The district surveyed was at an altitude of about 6,300 ft. and comprised two areas, Lake Bunyonyi and the valleys. Meteorological data for 1945 and 1946 are given.

Previous surveys had indicated that large numbers of *Anopheles funestus* Giles were found around Lake Bunyonyi and that no other vector was present there, except perhaps a few individuals of *A. christyi* at Bufundi, whereas both these species and also *A. gambiae* Giles and *A. marshalli* (Theo.) var. *gibbinsi* Evans occurred in the valleys, where *A. christyi* was apparently the chief domestic species. In the 1947 survey, huts around Lake Bunyonyi were found to contain fairly large numbers of *A. funestus*, those sheltered in bays being more heavily infested than those on headlands. Of 275 females dissected for sporozoites, six had rather heavy infections. Grain stores and latrines yielded very few mosquitos. *A. funestus* apparently breeds only in the papyrus fringe of the lake and particularly in the thick belts that choke the small bays. Larvae were found in water about 2 ft. deep near the land with thick papyrus and reeds but little surface vegetation. A search of 38 huts in various places in the Kigezi valleys yielded only nine individuals of *A. kingi* Christ., three of *A. marshalli* and one each of *A. funestus*, *A. gambiae* and *A. christyi*. One example of *A. christyi* was found under the thatch of a grain store. As former workers had found many adults of *A. christyi* in the huts of this area, it is presumed to have a well-marked seasonal incidence. Temperatures are near the limit for *A. gambiae* but are always suitable for *A. funestus*.

Details of spleen and parasite rates are given. They showed a fair degree of endemic malaria on Lake Bunyonyi, with a spleen rate of 80 per cent., while in other areas malaria is more seasonal with a spleen rate varying from 10 to 25 per cent.

LEES (A. D.). **The sensory Physiology of the Sheep Tick, *Ixodes ricinus* L.**—*J. exp. Biol.* **25** no. 2 pp. 145–207, 31 figs., 58 refs. London, 1948.

The following is based on the author's summary. An unfed individual of *Ixodes ricinus* (L.) at rest adopts either a " questing " attitude with the forelegs extended or an attitude of repose with the forelegs folded. While walking, the hungry tick waves the forelegs like antennae. A tick walking on a glass rod, which serves as a model of a grass or rush, usually climbs to the tip, quests, and then walks up and down near the tip before coming to rest there. This response involves a taxis (upward-turning near the tip) and a kinesis. Negative geotaxis may be of some significance, but reasons are given for supposing that the behaviour is partly a tactile response following arrival at the tip. When the water balance of unfed ticks is normal, they avoid higher humidities but come to rest equally readily in moist or dry air. The avoiding response (taxis) disappears after desiccation and is replaced by a kinesis ; the tick is then

intensely active in dry air, but soon comes to rest in moist air, where the water balance is restored by water uptake through the cuticle. The first response then reappears. The operation of the kinesis does not seem to depend on sensory stimulation. The taxis is weakly developed in normal engorged ticks, but the kinesis is again strongly manifested after desiccation. Unfed ticks with their legs folded respond to vibrations by questing instantly and readily cling to any object that brushes against them. The formation of densely packed larval clusters is a further response to contact stimulation. Hungry ticks orienting to an odourless tube warmed to 37°C. [98·6°F.] either approach it eagerly and climb on it or avoid it. Larvae and nymphs are usually attracted and adults repelled. The response is to a gradient of air temperature and not to radiant heat. Objects at any temperature higher than that of the surroundings may prove attractive, but avoiding responses are always elicited by temperatures higher than 42°C. [107·6°F.]. In a linear gradient extending from 8 to 45°C. [46·4 to 113°F.], ticks aggregate rapidly in the coldest region after previous exposure to 25°C. [77°F.]. Fewer cold-adapted ticks are trapped in this way ; those remaining outside the coldest region show no definite " preferendum " within the range 11–41°C. [51·8–105·8°F.]. Below 20°C. [68°F.], ticks are indifferent to the odour of sheep wool alone. At higher temperatures, wool is slightly attractive. In the presence of a temperature gradient (wool wrapped round a tube at 37°C.), the odour becomes highly attractive. Thus, hungry adults that are repelled by temperature alone are attracted when both stimuli are presented together. They respond with equal vigour to the scents of dog, rabbit, cow and horse hair. Unfed ticks at rest on a glass rod respond to a sudden fall in light intensity by questing. Engorged ticks are strongly photonegative ; newly moulted ticks also avoid a directed illumination, but become indifferent as they age. The sense organs that determine the responses are described.

By offering warm or cold membranes for attachment, it was found that temperature, smell and a factor of the fleece perceived as a contact stimulus by the palpal organ provide the necessary stimulation for attachment. Most ticks attach to the natural host if the forelegs or the palps are amputated. None attaches if both are lacking. A questing response to light or vibration is often followed by movement. This mechanism (orthokinesis) is also very important in the behaviour of the desiccated tick with regard to humidity. Random changes in the direction of locomotion (klinokinesis) rarely occur. The usual response to favourable or unfavourable stimuli (such as temperature, smell and humidity) is directed and involves successive comparisons of intensity by the sensillae borne on the forelegs (klinotaxis). There is no tropotactic component, for ticks lacking one foreleg can still locate such stimuli accurately.

An important physical feature of the rough moorland grazings that form the main habitat of the sheep tick in Britain is the steep humidity gradient within the vegetation. Near the roots, where the tick remains quiescent for long periods, the atmosphere is permanently moist ; at the tips of the vegetation, where it rests during the active period, humidities are variable but generally lower. All the sensory perceptions are of value in promoting survival or host-finding. First, certain reactions, particularly the upward-turning response, guide the tick to a situation favourable for encountering a host. The tendency to remain near the tips of vegetation is helped at first by the humidity response. After an unsuccessful period of waiting, the tick becomes desiccated and the kinesis comes into play, causing it to descend to the roots, where it takes up water from the damp atmosphere, and is then prepared for a further period of activity at the tips. Secondly, responses to tactile stimuli (unusual movements of the vegetation) and to light (shading) provide warning of the imminent approach of the host. Thirdly, orientation to the warmth and scent of the skin take place when the host is very near, and the tick then catches hold and

climbs on. After the engorged tick has dropped from the host, its movements into the deeper layers of vegetation are guided by the avoidance of directed illumination and to some extent by sensations of contact.

HARE (K.). **Studies in Tropical Ulcer. Part I. The Origin of an Epidemic.**—*J. trop. Med. Hyg.* **51** no. 3 pp. 47–53, 2 figs., 2 maps, 7 refs. London, 1948. **Part II. The Aetiology of Tropical Ulcer.**—*T.c.* no. 4 pp. 72–81, 18 refs. **Part III. The Insect Vector.**—*T.c.* no. 5 pp. 99–103, 12 refs. **Part IV. The Treatment of Tropical Ulcer.**—*T.c.* no. 6 pp. 119–128, 26 refs.

In the first part of this paper, an account is given of the course of an epidemic of tropical ulcer (locally known as Naga sore) that began in 1942 in the Tingri district in the plains of Assam. The outbreak in this district, which is typical of many formerly unaffected areas, began with the return of labourers from war work in the infected hills, built up in 1943–45 and reached epidemic proportions in 1946 with an average incidence of over 5 per cent. of the population on various estates.

The second part comprises a discussion of the etiology of the ulcers, with the conclusion that the fusiform bacillus usually found in them but often thought to be merely a contamination is present at all stages and is the causal organism. Only man is susceptible to the disease, which is confined to warm countries and in them to seasons of moderate heat and rainfall. It can be maintained in a community without any carry-over of cases from one season to the next, and is always associated with rural or semi-rural conditions, but it requires a fairly high density of population for successful propagation. Most ulcers occur on the lower part of the leg, and only adults and older children of the labouring classes are usually affected. These facts are thought to indicate that the disease is transmitted by an arthropod, probably a crawling one.

In the third part, the possible importance of *Siphunculina funicola* (de Meij.) [*R.A.E.*, B **16** 252 ; **19** 60], household insects and outdoor winged insects as vectors is discussed, but they are dismissed, on account, respectively, of distribution, the scarcity of cases in children and the tendency of the ulcers to occur on the lower limbs only. Since adults and older children visit the scrub jungle frequently, whereas young children do not, it is concluded that the most likely vector is some crawling arthropod that spends the greater part of its time in jungle or rough vegetation and can retain the infection from one year to the next. Those that best fulfil these conditions are ticks and Trombiculid larvae. Both are common in most, probably all, the countries where tropical ulcer is known, they are found chiefly in rough vegetation and jungle, they prefer moist heat and they can retain certain other infections from year to year.

PAPERS NOTICED BY TITLE ONLY.

HASSALL (A.), DOSS (M. A.), SEGAL (D. B.) & RAY (D. H.). **Index-catalogue of Medical and Veterinary Zoology. Part 12. Authors : P to Qvortrup.**—pp. 3721–4054. Washington, D.C., U.S. Dep. Agric., 1951. Price $1.00 (from Supt. Documents). [*Cf. R.A.E.*, B **38** 108.]

METCALF (R. L.) & MARCH (R. B.). **Properties of Acetylcholine Esterases from the Bee, the Fly and the Mouse and their Relation to Insecticide Action.**—*J. econ. Ent.* **43** no. 5 pp. 670–677, 4 figs., 22 refs. Menasha, Wis.,1950. [See *R.A.E.*, A **39** 174.]

LOVETT (W. C. D.). **Control of Mosquito Breeding by the Use of D.D.T. Solution absorbed on Briquettes.**—*E. Afr. med. J.* **24** no. 5 pp. 196–198, 2 refs. Nairobi, 1947.

In British Somaliland, wells are the only source of water and consequently of mosquitos in most districts for the greater part of the year. In an experiment on the control of breeding in one small village having six wells 3–4 ft. in diameter, briquettes impregnated with DDT in oil were dropped into five of the wells on 1st and 15th October at the rate of one per well on each date. All five had contained larvae before treatment began, but only one second-instar larva was found on 15th October and two larvae on 12th November. No adults were seen at either inspection. The sixth well, in which no mosquitos in any stage were seen at the first inspection, was not treated and remained free of mosquitos. The briquettes were 1-in. cubes made of sawdust and plaster of paris (2 : 1) ; they were soaked in a 5 per cent. solution of DDT in dieseline for 48 hours, and each absorbed about 7·5 cc. solution. The method was much simpler and cheaper than weekly oiling and could be carried out by the inhabitants in small villages where no control has hitherto been practicable.

JACKSON (C. H. N.). **The Analysis of a Tsetse-fly Population. III.**—*Ann. Eugen.* **14** pt. 2 pp. 91–108, 2 graphs, 7 refs. Cambridge, 1948.

The basic data for this study, obtained by recapture of marked adults of *Glossina morsitans* Westw. released weekly at Kakoma in Tanganyika Territory between 1935 and 1940, have been fully set out in the previous papers of the series [*R.A.E.*, B **34** 196, etc.]. The results of some later work with unmarked flies released outside their areas are tabulated, and because of these results, some of the earlier conclusions are modified. Various improvements have been made in the method of treating the data, and as this is intended to be the last paper of the series, the method of calculating population and its changes, as now used, is briefly recapitulated, and a new method of calculating population from re-recaptures is described. The new method is based on the assumption that the ratio of catch to population in a given week is equal to the proportion of flies marked in the previous week and recaptured for the second time among marked flies recaptured in the succeeding week.

The following is based on the author's summary. The theoretical formula for the variance of the emergence and immigration or death and emigration rate is checked from the actual data. Short-term fluctuations in death rate and emergence rate appear to be governed by factors temporarily intrinsic in the local population, which prevent any close association with short-term changes in climate. Marking of flies with oil paints caused some immediate deaths in the dry season if the mark was large, but there was no evidence of any continuing effect such as might influence the estimated death-rates [*cf.* **29** 161], and there was no effect in captivity. Experiments with unmarked flies in 1944–46 showed that the males are relatively inactive for about the first two weeks of life [*cf.* **34** 199], and their death rate may then be less than it is later. There is no evidence of a later decline in activity with advancing age. The early inactivity affects the interpretation of the survival curves [**29** 123] and the estimate of mean life. This, however, still appears to be about four weeks for males [*cf.* **29** 124]. Early inactivity provides an explanation of the observation that the mean age of samples of wild males judged from wing-fray [*cf.* **34** 199] is greater than mean expectation of life estimated from marked flies. Early inactivity implies that marked-fly experiments do not give an estimate of the whole male population, and the estimate should be increased by about 1·4 times to include the relatively inactive younger males. Estimating population from re-recaptures generally gives values rather higher than those obtained by extrapolation, but when life is short the re-recapture method gives very much higher estimates. The reason for this is not known.

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Herms (W. B.). **Medical Entomology, with special Reference to the Health and Well-being of Man and Animals.**—$9\frac{1}{2} \times 6\frac{1}{4}$ ins., 4th edn. (revd.), xvi+[1+]643 pp., col. frontis., 191 figs., many refs. New York, N.Y. and London, MacMillan Co., 1950. Price 67*s.* 6*d.*

The general arrangement of this fourth edition is essentially the same as that of the third [*R.A.E.*, B **27** 189], but most of the chapters have been re-written to incorporate new knowledge. In particular, sections on control have been completely revised in view of alteration in technique owing to the discovery of DDT and other synthetic organic insecticides.

Heisch (R. B.) & Garnham (P. C. C.). **The Transmission of *Spirochaeta duttoni* Novy & Knapp by *Pediculus humanus corporis* De Geer.**—*Parasitology* **38** no. 4 pp. 247–252, 10 refs. London, 1948.

Nicolle's theory that tick-borne spirochaetes are gradually changed into louse-borne ones by adaptation to the new host [*R.A.E.*, B **16** 51] has been widely accepted, but the only experimental evidence hitherto in support of transmission of a tick-borne spirochaete by lice has been the work of Nicolle & Anderson on *Spirochaeta hispanica* [**14** 193–194 ; *cf.* also **21** 166, etc.], and some have stated that the tick-borne *S. duttoni* is not infective for the louse. Accounts are given of seven experiments in which cyclical development of this spirochaete in *Pediculus humanus humanus* L. (*P. h. corporis* Deg.) was observed. In the last four, the same strain was transmitted through four successive batches of lice without alteration of its character. The name *S. duttoni* is used for the spirochaete responsible for the well-known relapsing fever of East Africa carried by *Ornithodoros*, and the name *S. recurrentis* for the spirochaete responsible for the first outbreak of louse-borne relapsing fever known to have occurred in Kenya [**39** 75]. The lice used were obtained from Nairobi, 250 miles from the site of the louse-borne epidemic, and the strain of spirochaetes was obtained from a patient living in a well-known *duttoni* area near Nairobi and was shown to be able to infect *Ornithodoros moubata* (Murr.) and *O. savignyi* (Audouin). The lice were fed first on infected monkeys and then twice daily on the authors. The presence of spirochaetes in the lice was demonstrated in Leishman-stained smears or by dark-ground illumination of saline emulsions, and the emulsion was used to infect animals. Spirochaetes were not seen in the lice until the 15th day, but the presence of infection was demonstrated by inoculation into animals as early as the second day. It is thought that this early infection and the others during the first ten days were caused by the organism in an invisible stage. The cycle appears to differ from that of the Kenya strain of *S. recurrentis* [**39** 76], in which a definite negative phase was observed. In both, however, the negative cycle in the louse was terminated by the appearance of metacyclic forms about the 15th day. The infections in mammals that resulted from passage through lice behaved exactly like *S. duttoni*, even after the fourth transmission through the abnormal host. The louse-borne *S. duttoni* protected against a tick-borne strain of this spirochaete but not against *S. recurrentis*. There was no antigenic difference between the first and third louse-transmitted infections. In view of these results, it is concluded that an epidemic of louse-borne relapsing fever caused by *S. duttoni* is possible, though two attempts to transmit *S. duttoni* to lice from human cases were unsuccessful.

Sharif (M.). **Nutritional Requirements of Flea Larvae, and their Bearing on the specific Distribution and Host Preferences of the three Indian Species of *Xenopsylla* (Siphonaptera).**—*Parasitology* **38** no. 4 pp. 253–263, 1 fldg. table, 40 refs. London, 1948.

The distances over which rat fleas could be transported in agricultural products in ships free from rats [*cf. R.A.E.*, B **23** 183 ; **36** 156] would be

increased if the larvae could develop in the products [**15** 223]. An account is given of experiments to investigate the nutritional requirements of the larvae of the three Indian species of *Xenopsylla*, *X. cheopis* (Roths.), *X. brasiliensis* (Baker) and *X. astia* Roths., and particularly whether they can develop in flour alone. Flour usually contains small quantities of the excrement and detritus of the insect pests that normally infest the grains. In addition to the results of the laboratory work, experience gained in the field over a period of three years during an inquiry into the recrudescence of plague in the district of Sholapur and Dharwar in the Bombay Province is considered. The methods and technique used are described.

The following is substantially the author's summary. The comparative nutritive value of dried horse blood, highly milled wheat flour devoid of bran, and mixed diets of blood and wheat flour and of blood and yeast for the larvae of *X. cheopis*, *X. brasiliensis* and *X. astia* was ascertained experimentally. Pure blood proved inadequate, probably because it is deficient in accessory food factors. The growth of the larvae on wheat flour alone was erratic. Only a proportion completed development, and the adults emerged after long and irregular periods. The successful development of some of the larvae is attributed to the association of micro-organisms, possibly fungi, with the flour. A mixture of blood and wheat flour accelerated larval development, but was not a satisfactory diet. Blood and yeast formed a perfect food for the larvae of all three species.

It is concluded that larval diets containing blood or wheat proteins and vitamins of the B group are essential for the successful rearing of the fleas, and that the proper sclerotisation of the adult is due to the presence of haemoglobin in the larval food. The available data on the effects of diverse diets on the growth of flea larvae lend strong support to the conclusion that successful development depends on the presence of the vitamins in the food ; it is also thought to indicate that their source in nature may be the association of micro-organisms with the food.

The larval food appears to be an important factor governing the distribution and host preferences of different species of flea. The larvae of *X. astia* need the most nutritive diet. This species flourishes if a rich larval food is present in a rodent burrow, as in the burrows of *Tatera indica* and *Bandicota malabarica*, and even in those of the domestic rats in certain regions. In contrast, the nutritional requirements of the larvae of *X. cheopis* and *X. brasiliensis* are simple. Thus, they prosper readily in burrows of the domestic rats, even where the nutritive value of the larval food is very low. As the temperature tolerance of *X. brasiliensis* is the lowest, this species is confined to some of the cooler regions. The irregular distribution of the three species in India may thus be related to differences in the nutritional value of the varied organic substances found in rat burrows in different places. The fact that *X. cheopis* and *X. brasiliensis* have a wider distribution than *X. astia* is attributed to the ability of their larvae to grow better on flour alone. This possibly enables them to survive prolonged transport in grain, even without rats.

Shute (P. G.) & Maryon (M.). **The gametocytocidal Action of Paludrine upon Infections of** *Plasmodium falciparum*.—*Parasitology* **38** no. 4 pp. 264–270, 5 refs. London, 1948.

Neither quinine nor mepacrine destroys gametocytes of *Plasmodium falciparum*. Plasmoquine does so, even in small doses [*cf. R.A.E.*, B **17** 246, etc.], and it has recently been shown by N. H. Fairley and his colleagues in Australia that minute quantities of paludrine prevent oöcysts from maturing in mosquitos even though they have established themselves on the outer wall of the mid-gut. An account is given of experiments confirming this. A patient

artificially infected with *P. falciparum* was given 0·8 gm. paludrine orally in two doses two days after the appearance of gametocytes in the peripheral blood and batches of 30 females of *Anopheles maculipennis* var. *atroparvus* van Thiel were thereafter allowed to feed on the patient, usually at intervals of 24 hours, for as long as gametocytes were present in sufficient numbers. They were dissected at various intervals after feeding, and the results are given in tables. In the control experiment, 87·5 per cent. of the mosquitos became infected and the number of oöcysts per gut in many cases exceeded 500. The infection rate fell to about 43, 35 and 23 per cent. in the mosquitos fed one, two and three days after the administration of paludrine, and the number of oöcysts per gut declined to a maximum of 10 by the third day. The percentage infection increased to 60 in those fed on the fourth day, with no increase in oöcysts per gut. There was no change on the fifth day, but on the sixth it was observed that some of the oöcysts continued their development in the gut, unlike those in previous batches, though they did not complete it. There was little change seven days after the administration of paludrine, and the batch fed on the eighth day was the first to have sporozoites in the salivary glands. They were few in number and occurred in only 2 of 19 mosquitos.

Fairley suggested that the paludrine does not act on the gametocytes until they reach the gut of the mosquito. The authors believe, however, that its action is confined to the female parasites and is a slow one. Many of the females are apparently destroyed or sterilised before fertilisation or penetration of the gut wall, and the others are affected by the drug, so that although they may penetrate the gut wall, they die a few days later, depending on the period that has elapsed since the administration of the drug.

Morley (F. H. W.). **Comparison of Manchester Operation with Mules Operation Modifications in Prevention of Flystrike in Sheep.**—*Agric. Gaz. N.S.W.* **60** pts. 10–12 pp. 543–548, pp. 571–575, pp. 655–657, 8 figs., 5 refs. Sydney, 1949.

An operation devised and patented in Australia by L. L. Manchester has proved very effective in reducing the susceptibility of sheep to crutch and tail strike by blowflies. It consists in removing the skin around the perineum and on the dorsum of the tail by the application of a chemical which is not specified in this paper. The edges of the treated areas draw together into a linear scar, so that the bare area round the vulva and below the tail stump is stretched and enlarged in much the same way as it is by Mules' operation in its modified form [*R.A.E.*, B **32** 142]. As, however, the tail is also treated, the Manchester operation is comparable with the combination of the Mules operation and the supplementary operation in which skin from the dorsum of the tail is removed [**37** 2].

Details are given of experiments in New South Wales in which the three treatments were compared, each on 97 sheep with short and 97 with medium-long tails. Both the Manchester and the combined Mules and tail operations gave practically complete protection once the wounds had healed, and most sheep were not seriously affected by the Manchester operation. However, they became weak and temporarily lost condition after the application of the chemical, and two died as a result of treatment. Moreover, healing was slow (still being incomplete after 11 weeks in many sheep) and pockets of pus in the wounds were subject to strike. The sheep were also subject to worry by *Musca vetustissima* Wlk. until healing was complete. Sheep that had been treated by the surgical methods, on the other hand, showed no signs of pain or ill effect, and wounds healed completely in five weeks and were not subject to strike. The amount of stretching effected by the Mules operation was slightly less than by chemical treatment but appeared adequate. The Mules operation

alone gave inferior results because it did not protect against tail strike, but was otherwise good. A more radical type of tail operation in which all wool-bearing skin was removed from the dorsum of the tail and above the base of the tail, the cuts joining those of the Mules operation, did not appear to offer any advantage over the simple removal of skin from the dorsum of the tail in sheep with medium and medium-long tails, but seemed to increase protection in short-tailed sheep. It increased the time required to perform the operation and retarded healing by 2–3 weeks.

No treatment significantly affected lambing percentages among ewes mated two months earlier or several months later.

EDDY (G. W.). **The Treatment of Head Lice with the MYL and DDT Louse Powders and the NBIN Emulsion.**—*Amer. J. Hyg.* **47** no. 1 pp. 29–32, 4 refs. Lancaster, Pa., 1948.

The following is mainly based on the author's summary. During the winter of 1944–45, over a thousand people infested naturally with *Pediculus humanus capitis* Deg. (*P. h. humanus* L.) were treated in Illinois and Indiana with MYL (a powder containing pyrethrins, N-isobutylundecyleneamide, 2,4-dinitroanisole and Phenol S [*R.A.E.*, B **34** 45]), 10 per cent. DDT in pyrophyllite, or NBIN emulsion (prepared from a concentrate containing benzocaine and DDT [**35** 188] diluted with five parts water). Most were children between the ages of 6 and 10 years. Comparatively few were known to have lice in mobile stages, but all had either lice or eggs. The powders were usually applied at not more than 4 gm. per person and the emulsion at about 20 ml. per person. On examination 8–10 days after treatment, no living lice were found on people treated with DDT or NBIN but some were present on three treated with MYL. It is concluded that the MYL powder cannot be depended on to give complete control in one application. More than twice as many women and girls as men and boys were found infested. More than 25 preparations, including kerosene alone or mixed with vinegar or olive oil, had previously been used by people on whom live lice were found, but probably some had been improperly applied.

REEVES (W. C.), WASHBURN (G. E.) & HAMMON (W. McD.). **Western Equine Encephalitis Control Studies in Kern County, California, 1945. I. The Effectiveness of residual DDT Deposits on Adult *Culex* Mosquito Populations.** —*Amer. J. Hyg.* **47** no. 1 pp. 82–92, 3 figs., 12 refs. Lancaster, Pa., 1948.

HAMMON (W. McD.) & REEVES (W. C.). **II. An Evaluation of the Effectiveness of certain Types of Mosquito Control including residual DDT on Virus Infection Rates in *Culex* Mosquitoes and in Chickens.**—*T.c.* pp. 93–102, 11 refs.

Investigations in California and Washington since 1941 have shown that the essential infection chain for the transmission of western equine encephalomyelitis is mosquito-bird-mosquito, that domestic fowls are commonly infected, and that *Culex tarsalis* Coq. is apparently the most important vector [*R.A.E.*, B **36** 193]. As part of a general survey of Kern County, California, in 1943 **36** 192] and 1944 [**38** 193], it was demonstrated in a mosquito abatement district that encephalitis infection continued to occur in fowls and mosquitos with numerous infections in horse and man when the mosquito population was kept at or just below the pest threshold for man.

In these papers, an account is given of the first attempts in controlled experiments to decrease the incidence of encephalitis by an attack on the mosquito vector. Only the western equine virus is considered. The studies dealt with in the first paper were designed to give an estimate of seasonal

fluctuations in the population of *Culex* mosquitos inhabiting certain domestic shelters within circumscribed areas, as a basis for the evaluation of mosquito abatement methods and for correlation with epidemiological observations, and to test the effectiveness of DDT deposits against adults of *C. tarsalis* in their domestic resting places and of combined larval and adult control measures. They were carried out in 1945 in two comparable areas 20 miles apart in Kern County, in the first of which the inside walls of all domestic fowl shelters in the experimental plot were sprayed with DDT, while in the second, where oiling of breeding places was already in operation, all fowl houses and also many other domestic animal shelters were treated.

The following is based on the authors' summary. It was observed in the two areas that apparent population trends of *C. tarsalis* and *C. fatigans* Wied. (*quinquefasciatus* auct.) were distinctly different. Numbers of *C. tarsalis* decreased rapidly before a noticeable fall in summer temperatures, while those of *C. fatigans* were still increasing. DDT deposits on the inside walls of buildings serving as resting places for *Culex* mosquitos were quite effective in reducing the number of mosquitos resting within the sprayed buildings. Much of the DDT in solution in diesel oil when sprayed on unpainted, dry wood at 200 mg. DDT per sq. ft. was carried below the surface, leaving almost no detectable or effective surface deposit after a few weeks. When applied in a quick-breaking xylene-water emulsion, DDT gave a better surface deposit, which was effective for at least 2·5 months. Any suitable micro-habitat left unsprayed in a building or the unsprayed surface of any article introduced after treatment could usually be found harbouring mosquitos, often in fairly large numbers. Complete coverage with DDT spray was essential for complete control, but it was impracticable in some instances. Costly, though limited, larval control measures in addition to treatment of fowl houses and other domestic animal shelters with DDT apparently caused only a moderate reduction in the population of *Culex* mosquitos over the area as a whole. There did not appear to be any reduction of a nature that would be significant in the reduction of a mosquito-borne infection unless local mosquito reduction in fowl houses (which was 90–95 per cent.) was of specific importance.

The effect of this local control on the fowl-mosquito-fowl infection chain is considered in the second paper. The following is based on the authors' conclusions. Rates of infection with the western equine virus remained high in *C. tarsalis* collected within the treated areas. As the numbers of *C. tarsalis* found in treated fowl houses were very small, it seems likely that many infected mosquitos found in other shelters had acquired infection from wild birds or other hosts within the experimental area. Contrary to expectation, however, females of *C. tarsalis* often took blood from fowls in shelters sprayed with DDT and lived at least long enough to be caught while resting outside the sprayed houses. Infection rates in samples of mosquitos were higher in the area where only fowl houses were treated than in the one where measures were directed against both adults and larvae, but the difference was just below the level of significance. The methods of control carried out in the two areas did not appear to decrease infection rates in surviving mosquitos. A serum-neutralization test survey at the end of the season of fowls less than one year old failed to show that a material reduction in the number of resting mosquitos in the fowl houses caused a proportionate or even significant decrease in the incidence of infection in the birds. There was apparently no foundation for the assumption that most females of *Culex* feeding on fowls would come to rest on the sprayed surfaces and remain until they received a lethal amount of DDT. Precipitin tests indicated that many mosquitos found outside fowl houses had fed on fowls and apparently had avoided, or at least temporarily escaped, the effect of DDT. Immunity rates in fowls and infection rates in mosquitos were not significantly lower in the area that had received the more

complete control than in the other, nor did the spraying eliminate the disease in horses, as one case occurred in the centre of the first of the two areas. Rates of clinical infection in man and horses for the county as a whole were too low to lend significance to the absence of additional cases in the two areas.

MONTOYA (J. A.) & OSEJO (P. P.). **Studies on the Use of DDT and Phenyl Cellosolve for Control of Pediculosis in Villages in Colombia.**—*Amer. J. Hyg.* **47** no. 3 pp. 247–258, 2 graphs, 10 refs. Lancaster, Pa., 1948.

The following is largely based on the authors' summary. Two studies on the control of body lice [*Pediculus humanus humanus* L.] and head lice [*P. h. capitis* Deg.] among the inhabitants of two small, primitive Colombian villages are described. The insecticides used were a dust of 10 per cent. commercial DDT in pyrophyllite or talc applied to the people and their clothing, beds and bedding against body lice, and a lotion of 5 parts phenyl cellosolve (β-hydroxyethyl phenyl ether [also known as ethylene glycol monophenyl ether]) in 47·5 parts ethyl alcohol and 47·5 parts distilled water applied as a shampoo against the head lice. In the first experiment, which lasted a year, techniques were developed for mass delousing, with a view to maintaining infestation at a level low enough to render the transmission of typhus unlikely. In the second, the aim was to determine the time needed for the infestation to reach its original level after one application of the insecticides to as many of the inhabitants as could be reached (98·2 per cent.). The percentages of people infested in this test were 76·8 before the treatment, less than 5 for four months after it, and about 46 after ten months.

It is concluded from the two experiments that careful application of the two insecticides to 98 per cent. or more of the population every four months will maintain the infestation rate at 5 per cent. or less. This figure is suggested as a tentative criterion of satisfactory performance in mass delousing programmes directed towards typhus control in primitive Latin American villages such as those studied. The communities and the technique and administrative procedures used are described.

PEMBERTON (C. E.). **Some Insect Pests of the Mainland of the United States occurring also in Hawaii.**—*Hawaii. Plant. Rec.* **51** no. 2 pp. 85–87. Honolulu, 1947.

The author gives a list of 134 common insect pests (including some 20 injurious to man or animals) that are established in Hawaii and also occur on the mainland of the United States. Its main object is to indicate the importance of the enactment and enforcement of quarantine regulations against mainland insects coming into Hawaii on aircraft and ships.

FLECK (E. E.). **Residual Action of organic Insecticides.**—*Industr. Engng Chem.* **40** no. 4 pp. 706–708, 24 refs. Easton, Pa., 1948.

In this paper, which is noticed in more detail elsewhere [*R.A.E.*, A **39** 207], the author reviews the chemical changes that are undergone by the pyrethrins, rotenone, phenothiazine and DDT when exposed in thin layers to the action of sunlight, air and the materials with which they may come in contact while in use, and the action of various materials added to them in inhibiting these changes.

FLECK (E. E.). **The Preparation of α,α,α′-4,4′-Pentachlorobibenzyl, an Isomer of DDT.**—*J. Amer. chem. Soc.* **70** p. 2173, 10 refs. Easton, Pa., 1948.

Attempts have been made to correlate the insecticidal action of DDT and related compounds with the presence of the parachlorophenyl groups or the trichloromethyl group and with the ease with which hydrogen chloride is liberated from the molecule [*cf. R.A.E.*, B **35** 101, etc.]. It has been stated by Martin that although high toxicity was not found in all the DDT analogues that are readily dehydrohalogenated, all those that showed high toxicity dehydrohalogenated readily in dilute alcoholic alkali [but *cf.* **36** 150–151]. In the investigation described, *dl*-α,α,α′,4,4′-pentachlorobibenzyl, a DDT isomer that resembles DDT in having two parachlorophenyl groups, a hydrolysable chlorine atom and sensitivity to the catalytic action of anhydrous ferric chloride, but in which both carbon atoms of the ethyl group are substituted with a parachlorophenyl group, was prepared, but it did not show toxicity when tested against house-flies [*Musca domestica* L.], Aphids, Lepidopterous larvae and Tetranychid mites. These results provide evidence that insecticidal action is due to the molecule as a whole rather than to the presence of toxic groups or specific reactions.

POLLOCK (J. S. McK.). **Plague controlled in Haifa by the Use of DDT alone.**—*Trans. R. Soc. trop. Med. Hyg.* **41** no. 5 pp. 647–656, 2 figs. London, 1948.

Plague has been known in Haifa for many centuries, and is of constant occurrence in rats. In 1947, an epizootic occurred among rats (predominantly *Rattus norvegicus*) and the infection spread to man before this was realised. An account is given of a campaign against rat fleas (begun the day after the appearance of the second human case, on 2nd July) in which basements, ground floors, streets, alleyways and courtyards in the affected parts of the city were sprayed with 5 per cent. DDT to leave a toxic deposit, and an immediate heavy application of the spray was also made to the house and workplace of each suspected case. In addition, the population were advised to use DDT persistent sprays in their houses and 10 per cent. DDT powder on their persons, and 30,000 people were treated at dusting centres in ten days. A further 13 cases occurred in the seven days after the campaign was begun, but only one was subsequently reported, from an area missed in spraying, although the epizootic among the rats continued unabated. The index for *Xenopsylla cheopis* (Roths.) fell from about three per rat in the first three days of July to less than one from 10th to 13th. It is concluded that the DDT was responsible for the cessation of the human cases. Measures taken to prevent infected rats being carried out of Haifa on lorries or in ships are also described, and notes are given on programmes that were set on foot for rat-control by poison and trapping and improvement of faulty sewers to abolish points of contact between man and rats.

FERGUSON (M. S.) & GRAHAM (O. H.). *Phlebotomus* **in New Guinea and nearby Islands.**—*Trans. R. Soc. trop. Med. Hyg.* **41** no. 5 pp. 679–684, 2 figs., 6 refs. London, 1948.

As it was thought that some cases of undiagnosed fever of short duration among troops in the south-west Pacific might be sandfly fever, surveys were made to determine whether *Phlebotomus* was present at bases in New Guinea and neighbouring islands. Only three unidentified females of *Phlebotomus* were known from New Guinea before the survey in 1944 that forms the subject of this paper. Collections were made by blowing tobacco smoke or dispensing insecticide from a liquefied-gas aerosol bomb in tree holes or around tree

buttresses and trunks and picking up the insects that fell on to white cloths spread under the treated area. By this method, several dozen sandflies were often collected from a tree hole or buttress. None was taken in light-traps. A list is given of the various widely separated army bases in New Guinea and the islands up to 90 miles from it in which sandflies were collected. The specimens found are being studied by D. J. Lee and M. Hertig. Lee states that all he has examined so far are undescribed, two or more species being represented. A limited search for *Phlebotomus* on Guam in March 1945 failed to reveal its presence, but no conclusion can be drawn from this.

Findlay (G. M.) & Archer (G. T. L.). **The Occurrence of Tick-borne Typhus in West Africa.**—*Trans. R. Soc. trop. Med. Hyg.* **41** no. 6 pp. 815–818, 1 graph, 3 refs. London, 1948.

The occurrence of murine typhus throughout West Africa has been amply demonstrated by the isolation of rickettsiae in guineapigs and by rickettsial agglutination and complement fixation tests, and an outbreak of louse-borne typhus occurred in Northern Nigeria in 1945 [*R.A.E.*, B **39** 78]. In this communication, brief descriptions are given of three cases of what appears to be tick-borne typhus occurring in Europeans, one on the Bauchi Plateau in Nigeria and two in Northern Ashanti on the Gold Coast, in the last three months of 1943. Weil-Felix reactions were positive. Agglutinins and complement fixing antibodies for murine and epidemic-typhus rickettsiae were absent from the sera, but complement fixing antibodies for South African tick typhus were present. Blood from the case from Nigeria, removed on the tenth day of illness, caused a thermal reaction when inoculated intraperitoneally into guineapigs, and although no definite scrotal reactions were seen, the tunica vaginalis was reddened and infected and smears stained by Giemsa's method showed a few rickettsiae in the cytoplasm of endothelial cells. The patient's dog gave a Weil-Felix reaction by the slide test with OX2 but not with OX19 or OXK.

Examples of *Rhipicephalus sanguineus* (Latr.) collected from both areas gave no reactions when inoculated into guineapigs.

Soman (D. W.) & Das Menon (V. K.). **Scrub Typhus (Mite Typhus) in Bombay with a Report on the Isolation of causal Rickettsia.**—*Indian med. Gaz.* **83** no. 1 pp. 17–20, 1 pl., 8 refs. Calcutta, 1948.

The diagnosis of 11 cases of tsutsugamushi disease (scrub typhus) in Bombay City in 1945 and 16 in 1946 by Weil-Felix reactions is recorded [*cf. R.A.E.*, B **39** 56], with confirmation of eight of the latter by isolation of the causal rickettsia (*Rickettsia orientalis*) in mice. The patients were of all ages and both sexes, and though it would not be expected that Trombiculid larvae would be present in the city, it is supposed that they occur because of the prevalence of rats. Most of the cases occurred in September, October or November, after the end of the rains, when conditions are most suitable for a rapid rise in mite population.

Savoor (S. R.), Vahia (N.S.) & Soman (D. W.). **Typhus in Bombay. Part I : Clinical Features.**—*Indian med. Gaz.* **83** no. 1 pp. 20–24, 11 refs. Calcutta, 1948.

Savoor (S. R.), Soman (D. W.) & Vahia (N. S.). **Part II : Epidemiology.**—*T.c.* pp. 52–53, 1 ref.

Savoor (S. R.), Vahia (N. S.) & Soman (D. W.). **Part III : Identification of Strains.**—*T.c.* no. 2 pp. 70–74, 15 refs.

In the first part of this paper, an account is given of the symptoms in 70 hospital cases of endemic typhus in Bombay City chosen for study out of more

than 200 diagnosed in two years (1944–45) and of the clinical course of the disease. A note on the rapid bed-side diagnosis of typhus is appended.

In the second part, it is pointed out that none of the 70 patients showed infestation with body lice [*Pediculus humanus humanus* L.] and only three had head lice [*P. h. capitis* Deg.]. The population of Bombay is clean, and only light clothing is needed even in winter. Louse-borne typhus is therefore unlikely to break out there. Rats are abundant. Cases of typhus occurred throughout the year, but were most numerous from January to June and least so during the monsoon, when rat burrows are flooded and sewers flushed.

The third paper includes a description of a method of isolating typhus strains and observations on the behaviour in laboratory animals of five strains that were isolated from man and one from a rat, which were shown by this means to be strains of murine typhus. In five successful experiments, two of the strains were transmitted between laboratory animals by *Xenopsylla cheopis* (Roths.).

PHILIP (C. B.). **Tsutsugamushi Disease (Scrub Typhus) in World War II.**—*J. Parasit.* **34** no. 3 pp. 169–191, 1 map, 30 refs. Lancaster, Pa., 1948.

Information on the epidemiology of tsutsugamushi disease acquired during outbreaks among the armed forces on active service in the Far East in 1943–45 is reviewed from the literature and from several unpublished military reports and documents. Aspects discussed include the Trombiculid vectors and susceptible vertebrates, the nomenclature of the causal agent, the incidence and characteristics of the disease in allied forces, with brief notes on its incidence in Japanese troops, its distribution and seasonal occurrence, and its epidemiology with special reference to military operations, island foci and grass associations. Finally, there is a short section on preventive measures, consisting of temporary personal protection or alteration of environment.

WEINSTEIN (P. P.) & PRATT (H. D.). **The Laboratory Infection of *Triatoma neotomae* Neiva with *Trypanosoma cruzi* Chagas and subsequent Transmission to white Mice.**—*J. Parasit.* **34** no. 3 pp. 231–236, 2 figs., 20 refs. Lancaster, Pa., 1948.

As *Triatoma neotomae* Neiva occurs in Texas and has been recorded as naturally infected with *Trypanosoma cruzi* there [*R.A.E.*, B **32** 195], experiments on the transmission of the trypanosome by it were carried out. Uninfected nymphs and adults became infected after a single feed on an infected mouse. Infected bugs did not infect healthy mice when fed on them in such a way that contamination by excreta did not occur, but inoculation of the excreta of an infected bug into mice produced typical infections.

CALERO M. (C.). **Cutaneous Myiasis in Panama.**—*J. Parasit.* **34** no. 4 pp. 343–344, 9 refs. Lancaster, Pa., 1948.

Records of cutaneous myiasis in man on the Isthmus of Panama between 1854 and 1934 are reviewed from the literature. Most cases were due to *Dermatobia hominis* (L. jr.) [*R.A.E.*, B **22** 162, etc.], and *Callitroga* (*Chrysomyia*) *macellaria* (F.) was alleged to be responsible for the others [*cf.* **6** 148]. Two cases seen by the author are described. One was caused by *Sarcophaga haemorrhoidalis* (Fall.) and the other by *Callitroga* (*Cochliomyia*) *hominivorax* (Coq.). As many cases attributed to *C. macellaria* elsewhere before 1933 were subsequently found to have been due to *C. hominivorax* [*cf.* **23** 11], it is thought that this probably applies in Panama also [*cf.* **25** 90].

PHILIP (C. B.). **Observations on experimental Q Fever.**—*J. Parasit.* **34** (1948) no. 6 pp. 457–464, 6 refs. Lancaster, Pa. [1949.]

The following is mainly taken from the author's summary of this account of miscellaneous laboratory experiments on the transmission of *Rickettsia* (*Coxiella*) *burneti*, the causal agent of Q fever. The rickettsiae did not appear to be transmissible by *Aëdes aegypti* (L.), either mechanically by interrupted, but undelayed, feedings between infected and susceptible guineapigs, or when refeeding was delayed for as long as 10–30 days. At 68–75°F., they did not persist in the bodies of the mosquitos for any considerable periods, even when the gut wall of freshly fed examples was punctured to assist penetration [*cf. R.A.E.*, B **24** 172].

In titration experiments with the faeces and tissues of *Dermacentor andersoni* Stiles, it was found that minute dosages were infective, the respective maximum titres being 10^{-10} and 2×10^{-12}. Saline suspensions of tick tissue, filtered through Berkefeld N and W candles, were still infective at 10^{-8}, the highest dilution tried. Faeces from infected *D. andersoni* were very rich in rickettsiae, which persisted in an infective state in faeces stored for as long as 586 days. Faeces stored at room temperature and 70 per cent. relative humidity for nearly six years still showed recognisable organisms on microscopic examination and antigenicity in serological tests, and they immunised when injected into animals, but no strains were recovered in animals or embryonated hens' eggs. Infection from tick faeces and from infected guineapig spleen pulp and spleen emulsion penetrated the unbroken skin, as well as the abraded skin of test animals. Animals also became infected when powdered faeces were dusted in the nostrils, eyes and mouth in separate tests. The rickettsia in adults of *D. andersoni* infected in the previous nymphal stage and stored after moulting for 63 and 129 days in a cold room at about 35°F. was highly virulent when single ticks were injected immediately on removal from chilling. Most of the test animals died after severe febrile courses and short incubation periods. This indicates another difference between *R. burneti* and *R. rickettsi* (Rocky Mountain spotted fever), which requires " reactivation " before the infection in chilled, fasting ticks reaches the maximum level of virulence.

The high degree of infectiveness of the rickettsia in the ticks used in the experiments described is in contrast to experience with ticks infected by feeding on animals into which had been injected yolk-sac culture material of strains passed for 99 and 115 consecutive passages in eggs. Tests to be reported elsewhere indicated that there was a reduction in virulence of the egg-adapted rickettsiae.

Two late-instar nymphs and an adult of *Triatoma infestans* (Klug) from an uninfected colony transmitted infection mechanically by interrupted feeding.

Infection was recovered from house-flies (*Musca domestica* L.) caught at large in a room in which animals infected with Q fever were kept. However, no success was obtained in attempts to transfer infection from infected to normal guineapigs kept separately, but in a common cage in which house-flies had free access to both. House-flies allowed to feed on moistened, infectious tick faeces and on infected spleen pulp were found to be contaminated with *R. burneti* when injected into test animals.

KRUSÉ (C. W.). **The Airplane Application of DDT for Emergency Control of Common Flies in the Urban Community.**—*Publ. Hlth Rep.* **63** no. 48 pp. 1535–1550, 7 figs., 3 refs. Washington, D.C., 1948.

Dispersal of DDT sprays from aircraft seems to be well suited for bringing about temporary fly control rapidly and effectively in urban areas during times of emergency. In this report, the design of aircraft spray equipment for this purpose and the performance of the sprays against the flies commonly found in

urban areas in the southern United States (chiefly *Musca domestica* L. and blowflies) are considered with reference to the results of experimental studies. The Stearman biplane used was equipped for the application of either sprays or thermal aerosols affording a wide variety of treatments ranging from very fine droplets to coarse sprays. It could treat 17 acres per minute with a 100-ft. swathe. A diagram of the dispersal equipment is given. In urban work, flying has to be at a height of about 150 ft., and the insecticides should be applied when the flies are most active, which is in the late morning, after winds and unstable air conditions have developed. Insecticides and solvents that stain cannot be used. Solutions of 20–30 per cent. DDT in the methylated naphthalenes were the materials chiefly tested. Velsicol NR–70 was initially used as the solvent, but was unsatisfactory because of staining. Four other fractions were therefore tried as substitutes, and on the basis of cost, staining and volatility, AR-60 was chosen. Field investigations on performance are described.

The following is mainly based on the author's summary and conclusions. Control with DDT depends jointly on direct contact with droplets and contact with a persistent deposit, but the relative effectiveness of the two types of action was not completely investigated. The toxicity of the deposit is of short duration and in view of many variables cannot be depended on to provide more than 25 per cent. kill. Emphasis was therefore placed on DDT dispersal to provide at least 75 per cent. kill by direct contact. Recoveries of more than 0·1 lb. DDT per acre were needed to effect such control with a spray having a median mass diameter (MMD) of 160–200 μ. Satisfactory control without staining can be obtained with a spray having a MMD of 200 μ applied from heights of 100–150 ft. The desirable rate of application is 0·5 lb. DDT per acre on the basis of a 100-ft. swathe, from a solution of 30 per cent. technical DDT in Velsicol AR-60. With the aerosols tested and multiple swathes, at least 90 per cent. control was obtained over only 15 and 65 per cent. of the area with droplets with MMDs of 100 and 150μ, respectively, as compared with 100 per cent. with sprays having droplets with MMDs of 160 and 200μ. Benzene hexachloride containing 10 per cent. γ isomer, also in a methylated naphthalene solvent and applied under the same conditions, appeared to be 5–7 times as toxic to the flies as DDT.

Hill (E. L.) & Morlan (H. B.). **Evaluation of County-wide DDT Dusting Operations in Murine Typhus Control.**—*Publ. Hlth Rep.* **63** no. 51 pp. 1635–1653, 8 figs., 10 refs. Washington, D.C., 1948.

The following is based on the authors' summary. Large scale investigations were carried out in two counties in Georgia where the probability of rural residents acquiring murine typhus was equal to or greater than that of urban residents doing so, to ascertain whether the disease could be controlled on a county-wide basis. Applications of 10 per cent. DDT in pyrophyllite were made to rat runs and harbourages in 60–96 per cent. of all premises in 1946 and 1947, and in the absence of other measures for the control of rodents, rodent ectoparasites or typhus, the incidence of murine typhus in man was significantly reduced in the two counties by comparison with previous experience in them and concurrent comparison with data from a neighbouring untreated county. The rats were predominantly *Rattus rattus*, but *R. norvegicus* was also present.

The DDT dusting operations disturbed the normal ecology of rats and rat-ectoparasite populations in various ways and may have contributed to the decline in typhus in man by this means as well as by killing ectoparasites. A significant reduction in the prevalence of typhus complement-fixing antibodies in the rat populations in the dusted counties closely followed

and was attributed to the ectoparasite control obtained. In comparison with populations observed in the untreated county, satisfactory control of *Xenopsylla cheopis* (Roths.) and *Leptopsylla segnis* (Schönh.) was effected, but populations of *Liponyssus bacoti* (Hirst) and *Polyplax spinulosa* (Burm.) were only slightly reduced.

Mandekos (A. G.), Damkas (C.) & Zaphiropoulos (M.). **Old and new Methods of controlling Malaria in Greek Macedonia.**—*Amer. J. trop. Med.* **28** no. 1 pp. 35–41, 3 refs. Baltimore, Md., 1948.

The results of malaria surveys carried out in Greek Macedonia from 1934 to 1946 are summarised, and inferences are drawn from spleen and parasite indices as to the effectiveness of the control measures used against Anophelines during that period. The villages and towns under consideration, which were representative of many more in the area, were divided into four groups according to the measures used. It was evident that applications of DDT, which were begun in 1945 or 1946 [*cf. R.A.E.*, B **37** 11], were much more effective than any measures taken before. This was true whether *Anopheles maculipennis* var. *sacharovi* Favr (*elutus* Edw.) or *A. superpictus* Grassi was the prevailing local vector. The DDT was used in houses as a spray to leave a toxic deposit of 0·43–1·8 gm. per sq. metre for the control of adult mosquitos and it was also applied by aeroplane at 28–40 gm. per acre to breeding areas for the control of larvae. During 1946, the measures were extended to include malarious areas throughout the whole of Greece, with very satisfactory results.

Giglioli (G.). **An Investigation of the House-frequenting Habits of Mosquitoes of the British Guiana Coastland in Relation to the Use of DDT.**—*Amer. J. trop. Med.* **28** no. 1 pp. 43–70, 6 figs., 1 graph, 3 refs. Baltimore, Md., 1948.

As the effectiveness of DDT in controlling mosquitos in houses depends on the house-frequenting habits of the individual species, these were studied for the species that occur on the coast of British Guiana, and the investigations are described in this paper. The results, which are given in detail for six different localities with varying hydrological characteristics, showed that *Anopheles darlingi* Root, the vector of malaria in the region [*cf. R.A.E.*, B **27** 229], is highly domestic in its biting and resting habits. It was taken in houses in all the localities examined and at all seasons, and formed about 26 per cent. of the mosquitos and well over 99 per cent. of the Anophelines caught in them. The average catches of this species in three localities near irrigated land were 22·2, 34·7 and 46·1 per room. It was not so plentiful in urban and suburban areas. It was active from dusk to dawn, being taken in greatest numbers two hours before sunrise, and 98·66 per cent. of the females collected in houses in daylight were heavily gorged with blood. Its favoured resting places were usually less than 7 ft. from the floor. It was very scarce in a trap baited with a cow. It was concluded that the prospects of controlling *A. darlingi* by spraying houses with DDT appeared excellent [*cf.* **37** 41]. The same could be said for *Aëdes aegypti* (L.), which was already held under control in the more densely populated centres by the classical measures. *Culex fatigans* Wied. was taken at average rates varying in the different localities from 3·35 to 78·8 per room, being particularly abundant where there were pit latrines susceptible to flooding. It formed about 66 per cent. of the mosquitos in houses, and 66 per cent. of females caught in them were gorged with blood. However, it also formed over 20 per cent. of the dawn catch in animal traps, most individuals taken in these circumstances being females. It was the commonest mosquito attacking domestic animals in the open, at night, in village yards. Because

of its eclectic biting habits, spraying of houses would have little effect on its total incidence, and supplementary measures against the larvae would be needed to control it effectively and prevent filariasis [caused by *Filaria bancrofti*], of which it is an important vector [see next abstract].

Anopheles albitarsis Lynch Arrib., *A. aquasalis* Curry and *A. triannulatus* Neiva & Pinto are common, but feed on animals. *A. triannulatus* was not taken in houses and the other two together represented only about 0·005 per cent. of the mosquitos found in them. *Aëdes taeniorhynchus* (Wied.), *Mansonia titillans* (Wlk.) and *Aëdomyia squamipennis* (Lynch Arrib.) entered houses occasionally, but it could not be expected that any of them would be influenced by the spraying of houses with DDT.

Giglioli (G.). **The Transmission of** *Wuchereria bancrofti* **by** *Anopheles darlingi* **in the American Tropics.**—*Amer. J. trop. Med.* **28** no. 1 pp. 71–85, 13 refs. Baltimore, Md., 1948.

As *Culex fatigans* Wied., *Anopheles darlingi* Root and *Aëdes aegypti* (L.) are the only mosquitos that habitually frequent houses and bite man on the coastland of British Guiana [see preceding abstract], the investigations here reported were undertaken to establish their relative importance in the transmission of filariasis caused by *Filaria* (*Wuchereria*) *bancrofti* [*cf. R.A.E.*, B **37** 41]. The following is based on the author's summary. Mosquitos were collected from a non-sewered suburb of Georgetown, which was highly infected with filariasis and in which *C. fatigans* (breeding in pit latrines) was the prevailing mosquito, and in a coastal sugar estate village drained by constantly flushed trenches where there was relatively little filariasis and *A. darlingi* was the dominant mosquito. Conditions here were typical of the coastal belt and similar to those of the interior. Notes are given on the technique adopted for dissection. In all, 19,407 mosquitos were dissected, some from houses chosen at random and some from houses where there were known to be cases of filariasis. The results of immediate dissections and of those made on mosquitos kept alive for 7 or 12 days after capture are compared. In both localities, the percentage of natural infection was very considerably higher in *A. darlingi* than in *C. fatigans*.

A series of comparative infectibility experiments indicated that *A. darlingi* was just as suitable a host for *F. bancrofti* as *C. fatigans*, its classical vector, but attempts to infect *Aëdes aegypti* failed completely. The feeding habits that make *Anopheles darlingi* the most effective malaria carrier of equatorial America also make it a particularly dangerous vector of filariasis. The distribution of the filarial embryos in *C. fatigans* and *A. darlingi* is discussed.

Waddell (M. B.) & Taylor (R. M.). **Studies on cyclic Passage of Yellow Fever Virus in South American Mammals and Mosquitoes. IV. Marsupials** (*Metachirus nudicaudatus* **and** *Marmosa*) **in Combination with** *Aëdes aegypti* **as Vector.**—*Amer. J. trop. Med.* **28** no. 1 pp. 87–100, 5 figs., 13 refs. Baltimore, Md., 1948.

The following is substantially the authors' summary of this fourth paper of a series [*cf. R.A.E.*, B **39** 71]. An account is given of experiments in which cyclical passages of strains of the virus of jungle yellow fever were made by using the oppossums, *Metachirus nudicaudatus* and *Marmosa cinerea*, as the animal hosts and *Aëdes aegypti* (L.) as the insect vector. The two marsupials are widely distributed through tropical and subtropical forests in South and Central America. A strain of virus isolated from a marmoset (*Callithrix penicillata*) caught in Ilhéus, in the State of Bahia, Brazil, where the disease is

endemic, was better adapted to passage through *Metachirus* than was a strain obtained from a human infection during a transient outbreak in Espírito Santo. After repeated passage by means of mosquitos through marmosets and *Metachirus*, the latter strain apparently became more suited to passage through *Metachirus* and was thereafter maintained in cyclic passage through this host without difficulty. While the two marsupials were easily infected with yellow-fever virus through the bite of the mosquitos, they did not so readily or so consistently infect normal mosquitcs as do two species of marmosets that were previously studied [**37** 214].

Ayroza Galvão (A. L.) & Damasceno (R. G.). **Alguns dados experimentais sôbre a ação do D.D.T. e do piretro contra o** *Anopheles darlingi*. [Experimental Data on the Action of DDT and Pyrethrum against *A. darlingi*.]—*Rev. Serv. esp. Saúde públ.* **1** no. 2 pp. 273–292, 3 figs., 5 graphs, 9 refs. Rio de Janeiro, 1947. (With a Summary in English.)

In connection with a programme of house spraying for the control of malaria vectors in the Amazon Valley of Brazil, experiments were carried out in an unpainted wooden house at Belém to test the effectiveness of deposits of DDT against *Anopheles darlingi* Root, breeding places of which occurred nearby. The interior of the house was sprayed in November 1945 with a 5 per cent. solution of DDT in kerosene to give an average deposit of 195 mg. per sq. ft., and adults of *A. darlingi* in it were caught at intervals thereafter and observed for mortality. The percentage mortalities eight hours after capture averaged 97·3, 96·4, 92·1, 95·3, 72·9, 67·7 and 42·2 during the seven months following treatment, respectively, as compared with 3·3–10·4 in an adjoining control house. It is concluded that treatment at intervals of four months would be required in regions such as this, in which *A. darlingi* breeds throughout the year, while the interval could be extended to six months in cooler districts where there is no breeding in winter.

In further observations, opening or closing the windows made little difference in the results obtained with DDT, and pyrethrum sprays gave high mortality on the nights on which they were applied but had no effect on subsequent nights.

Deane (M. P.). **Ocorrência do** *Trypanosoma conorrhini* **em "barbeiros" e em rato na cidade de Belém, Pará, e seu cultivo em meio de NNN.** [The Occurrence of *T. conorhini* in *Triatoma* and in Rat in the City of Belém, Pará, and its Culture in NNN Medium.]—*Rev. Serv. esp. Saúde públ.* **1** no. 2 pp. 433–448, 6 pls., 2 refs. Rio de Janeiro, 1947. (With a Summary in English.)

Several examples of *Triatoma rubrofasciata* (Deg.) taken in houses in Belém, Pará, and a rat (*Rattus rattus alexandrinus*) taken in the ceiling of one of them proved to be infected by *Trypanosoma conorhini*. In view of this, care should be taken in the identification of trypanosomes found in Triatomines and wild and domestic mammals in surveys for *T.* (*Schizotrypanum*) *cruzi*.

Thomas (I. M.). **The Reactions of Mosquito Larvae to regular Repetitions of Shadows as Stimuli.**—*Aust. J. sci. Res.* (B) **3** no. 1 pp. 113–123, 3 figs., 12 refs. Melbourne, 1950.

The following is the author's summary. Two factors are involved in the diving reaction of larvae of *Culex fatigans* Wied., a kinetic stimulus which initiates movement and a directional stimulus. The kinetic stimulus may be a water vibration, a change in light intensity, or a mild electric shock. The directional stimulus is normally a combination of light and gravity.

Regular repetitions in change of light intensity as a stimulus result in a diminution in the degree of response. The rate of diminution is affected by the number of larvae present and their age. The decrease in relation to age is probably to be associated with their increasing oxygen requirements.

Heisch (R. B.). **Rhodesian Sleeping Sickness in Kenya Colony.**—*J. trop. Med. Hyg.* **51** no. 11 pp. 225–227, 1 ref. London, 1948.

In the past, the only definite record of sleeping sickness caused by *Trypanosoma rhodesiense* in Kenya Colony was in 1942, when a few natives in central Kavirondo were affected by an extension of an epidemic in Uganda [*R.A.E.*, B **33** 101]. Descriptions are here given of two cases of infection, one in a European and one in an African, acquired in western Narok District, in the south-western part of the Colony, and of the behaviour of polymorphic trypanosomes recovered from them in laboratory animals. The acute symptoms caused in man and the virulent infections produced in white rats and other animals with the appearance of posterior nucleated forms indicated that the trypanosome involved was *T. rhodesiense*. *Glossina swynnertoni* Aust. is the most prevalent tsetse in the area and was the most likely vector. Some 500 of 1,360 individuals caught in nature fed on rats, and polymorphic trypanosomes were recovered from some of these. The strains from the fly caused the same reactions in laboratory animals as those from the human cases, but were non-pathogenic for man ; they were probably *T. brucei*. *G. palpalis* (R.-D.) was not found in the area. *G. pallidipes* Aust., the vector in the Uganda epidemic [*loc. cit.*], is present, and if *T. rhodesiense* became established in it, there would be danger of the infection spreading over the greater part of Kenya. In experiments on the susceptibility of laboratory-reared *G. swynnertoni* and *G. palpalis* to infection with trypanosomes recovered from the European case, 11·4 and 2·3 per cent., respectively, became infected.

Papers noticed by Title only.

Hall (S. A.). **Report on Tetraethyl Pyrophosphate** [methods of analysis].—*J. Ass. off. agric. Chem.* **33** no. 3 pp. 761–763, 2 refs. Washington, D.C., 1950. [See *R.A.E.*, A **39** 209.]

Bowen (C. V.). **Report on Benzene Hexachloride** [methods of analysis for γ isomer].—*J. Ass. off. agric. Chem.* **33** no. 3 pp. 774–782, 21 refs. Washington, D.C., 1950. [See *R.A.E.*, A **39** 209.]

Edwards (F. I.). **Report on Parathion** [methods of analysis].—*J. Ass. off. agric. Chem.* **33** no. 3 pp. 783–787, 12 refs. Washington, D.C., 1950. [See *R.A.E.*, A **39** 210.]

Fleck (E. E.). **The Action of ultraviolet Light on DDT.**—*J. Amer. chem. Soc.* **71** pp. 1034–1036, 7 refs. Easton, Pa., 1949. [See *R.A.E.*, A **39** 208.]

Lord (K. A.). **The Sorption of DDT and its Analogues by Chitin.**—*Biochem. J.* **43** no. 1 pp. 72–78, 3 refs. Cambridge, 1948. [See *R.A.E.*, A **39** 208.]

Waterhouse (D. F.). **Studies of the Physiology and Toxicology of Blowflies. XIV. The Composition, Formation, and Fate of the Granules in the Malpighian Tubules of *Lucilia cuprina* Larvae.**—*Aust. J. sci. Res.* (B) **3** no. 1 pp. 76–112, 1 pl., 2 figs., 1 fldg. table, 3 pp. refs. Melbourne, 1950.

Buonomini (G.), Sicca (G. T.) & Manfredi (M.). **La malaria all'isola d'Elba.** [Malaria on the Island of Elba.]—*Riv. ital. Igiene* **8** no. 1–2 pp. 1–12, 1 map, 1 graph. Pisa, 1948.

Malaria has long been present on Elba, but little is known of its history there. There was a small outbreak in 1946, however, and investigations were made between September of that year and the end of 1947. A survey showed that there were three malarious areas, comprising the communes of Portoferraio, on the north coast, and Porto Azzurro and Capoliveri on the east and south. The only Anopheline found in these was *Anopheles maculipennis* var. *labranchiae* Flni., which was breeding in irrigation water and along grassy streams in cultivated land and in wells and brackish stagnant water near the coast. Of the adults caught in buildings, 94·4 per cent. were taken in cattle sheds, stables and pigsties, especially the last, and only 5·5 per cent. in houses, and as breeding places were near, 17·3 per cent. of them were males. Numbers were not excessive. Egg development ceased in mid-October, and the first oviposition occurred in March, the population reaching its peak in June. *A. claviger* (Mg.) (*bifurcatus* auct.) was found at the edges of the malarious areas, adults being taken in houses on mountain slopes and larvae observed in shaded mountain streams, but it was never associated with *A. m. labranchiae*, even in breeding places that appeared suitable for the latter, and showed no tendency to supplant it.

The causes of the outbreak were unknown, but may have included increased Anopheline breeding owing to war-time neglect of drainage and irrigation ditches and the presence of numbers of gametocyte carriers among troops temporarily stationed in the island or returning from war service. Observations on its course in 1946 and 1947 showed that a few primary cases occurred in the winter, possibly owing to infection acquired in the previous autumn, but that the main peak was in July–August. It was due to *Plasmodium vivax*. Control measures in 1946 were limited to the distribution of drugs, the cleaning of ditches, some drainage work and dusting of breeding places with paris green, but in 1947 a campaign was begun to control or exterminate *A. m. labranchiae* by DDT sprays applied in buildings [*cf. R.A.E.*, B **38** 130]. The sprays used were a 26 per cent. solution of DDT in xylene emulsified in water in the proportion of 1 : 9 and a 5 per cent. solution of DDT in kerosene and these were applied to give deposits of about 2 and 3 gm. DDT per sq. metre, respectively. Spraying was begun in mid-June and was completed in all three areas by 1st August. To check the results, three pigsties were originally left unsprayed, and though no mosquitos were afterwards observed in treated premises, a few were taken in these and larvae were found in breeding places nearby. The pigsties were then sprayed, and subsequently proved free from mosquitos. A month after the conclusion of spraying, however, larvae were again observed in breeding places, and it appeared that *A. m. labranchiae* was not restricted to domestic environments, so that treatment of buildings would not lead to its extermination unless supplemented by treatment of breeding places. All these were subsequently oiled or treated with paris green, and in observations continued until mid-December, no further larvae or adults were found. The treatment of buildings resulted in a great reduction in the number of malaria cases as compared with the previous year, and none occurred from August onwards.

Chow (C. Y.). **The Anopheline Mosquitoes of Taiwan (Formosa), China.**—*Quart. J. Taiwan Mus.* **2** no. 1 pp. 1–8, 25 refs. Taipei, 1949.

The Anophelines here recorded from Formosa comprise in addition to those already noticed [*R.A.E.*, B **24** 254, 255; **37** 38] *Anopheles barbumbrosus* Strickl. & Chowd., *A. leucosphyrus* Dön., *A. subpictus indefinitus* (Ludlow) and

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A. fluviatilis James. Keys to the females and fourth-instar larvae are given, together with a table showing distribution within Formosa, based on the records of Japanese workers and the author's observations between August 1946 and January 1949, and notes on breeding places and in some cases morphological characters.

Gómez (L. M.) & Millares Mañana (A.). **Técnica para la separación de los exocorions en los huevos de los culícidos.** [A Technique for separating the Exochorions of Mosquito Eggs.]—*Rev. ibér. Parasit.* **8** no. 2–3 pp. 348–353, 1 fig. Granada, 1948.

The exochorion of the eggs is important for the classification of certain mosquitos of the genera *Anopheles* and *Culex*, but is not clearly visible under the microscope because of the opacity of the endochorion. The authors therefore sought a method for separating the exochorion from the rest of the egg and found that when a few drops of xylene were dropped on a *Culex* egg-raft on a slide, the eggs were expelled from their exochorions. It is thought that the xylene enters through the micropyle and penetrates between the exo- and endochorion, dissolving the fatty substances there present and causing the exochorion to rupture owing to the pressure. In tests on separated eggs, xylene, chloroform, carbon bisulphide, petrol and petroleum oil all produced the same result, but as petroleum oil acted less violently, with consequently less danger of injuring the exochorions, it was selected for subsequent use. The technique of separating the exochorions from eggs of *Culex* or *Anopheles* is described, and its results are illustrated from eggs of *C. fatigans* Wied.

Penido (H. M.) & others. **Malária no Vale do Rio Doce. Organização e execução de serviços antilarvários.** [Malaria in the Valley of the Rio Doce. Organisation and Execution of anti-larval Control.]—*Rev. Serv. esp. Saúde públ.* **1** no. 3 pp. 711–736, 2 maps, 2 refs. Rio de Janeiro, 1948. (With a Summary in English.) Repr. from *Rev. Hig. Saúde públ.* **5** no. 2 pp. 3–25. Rio de Janeiro, 1947.

Braga (E.) & others. **Malária no Vale do Rio Doce. Expurgo domiciliar com DDT em suspensão aquosa. 1a. Fase.** [Malaria in the Valley of the Rio Doce. Domestic Control with DDT in Water Suspension. First Phase.] —*T.c.* pp. 737–776, 3 maps, 3 graphs, 14 refs. (With a Summary in English.) Repr. from *Rev. Hig. Saúde públ.* **5** no. 2 pp. 26–59. Rio de Janeiro, 1947.

In these two papers, accounts are given of work on the control of malaria along a section of the railway that follows the valley of the Rio Doce, in the State of Minas Gerais, Brazil, by means of an attack on the mosquito vector, *Anopheles darlingi* Root [*cf. R.A.E.*, B **38** 45]. The first is concerned with the application to breeding places of dusts containing paris green, which began in 1943, and is largely devoted to the way in which the work was organised. The area was divided into zones and surveyed for breeding places, and the latter were dusted during the dry season (May–October), emergent vegetation being sometimes removed beforehand. Treatment was repeated weekly in a given zone until no larvae were found for a period of 6–8 weeks, and it was then suspended, though periodic inspection was continued. Treatment was resumed if larvae were again found. Two large breeding places are cited as examples. In one of them treatment in the first year led to complete control, and larvae were still absent three years later, while in the other they reappeared after two years, were again eliminated, and were then still absent after another

year. The work was concentrated in two areas at either end of the malarious section, and as a result of it, cases of the disease were absent in one of them in 1947 and almost absent in the other.

The second paper contains a similar account of work begun in 1946 on the effect of spraying the inside walls and roofs of houses with DDT to leave a deposit toxic to mosquitos. Wettable-powder suspensions were chiefly used, and deposits of 2 gm. DDT per sq. metre were applied. The area chosen for the investigation was one in which little or no work against larvae was in progress, and after a preliminary survey, about 85 per cent. of the houses in it were treated between September and December 1946 and again between January and April 1947, after an interval of four months. This led to a very great reduction in the numbers of Anophelines taken in the houses, but no diminution in larvae in breeding places. Promising reductions in malaria transmission were obtained, the parasite index for May falling from 19·7 per cent. in 1946 to 6·5 in 1947, and the number of cases reported for treatment during January–March in the same years from 4,321 to 1,041.

CORRADETTI (A.). **Aspectos del problema malárico mundial y medios para su solución en la costa del Perú.** [Aspects of the World Problem of Malaria and Ways of solving it on the Coast of Peru.]—15 pp. Lima, Dir. gen. Salud publ., Dep. Malar., 1947. **Bases experimentales para la eliminación de la malaria en la costa del Perú.** [Experimental Bases for the Elimination of Malaria on the Coast of Peru.]—14 pp., 2 graphs. 1947.

In the first of these two lectures, the author reviews the various conditions in which malaria is transmitted in different parts of the world and points out that *Anopheles pseudopunctipennis* Theo. is not a very efficient vector in the coastal valleys of Peru, since transmission occurs only in the season when the mosquito population reaches a very high level as a result of the numerous breeding places formed when the rivers shrink [*cf. R.A.E.*, B **34** 148]. In view of this and the good results given in Italy in 1946 by spraying with DDT to leave a toxic deposit in houses against *A. maculipennis* var. *labranchiae* Flni. [*cf.* **38** 130–131], a similar attempt to interrupt the cycle of transmission by *A. pseudopunctipennis* was begun in the Mala valley in 1947.

The second lecture comprises an account of the work and its results. A solution of DDT in kerosene was applied between 16th January and 12th March to the walls and ceilings of all the houses in the valley (from the coast as far as La Capilla) to leave a deposit of 2 gm. per sq. metre, and the results were estimated from comparison of the parasite indices of children not more than 12 years old and identification of parasites in them and in cases reported for treatment. The parasite indices of the valley had in previous years varied between 11 and 28·9 per cent. at the end of the endemic season (July) and between 13 and 21·8 per cent. at the end of the interendemic season (December), whereas in 1947 the index was 4·4 in February and 0·9–0·5 in March–July, when the incidence of the disease is usually at its highest. *Plasmodium falciparum*, which had previously been responsible for a fair proportion of the parasite index, was absent. Of the seven patients found to be suffering from malaria in the same months, all had had the disease in the preceding year. Malaria transmission had thus been eliminated throughout the season. Nevertheless, there was no apparent diminution in the numbers of larvae of *A. pseudopunctipennis* in breeding places, which was doubtless a result of the restricted association of this species with man. Reductions in other infectious diseases were also reported in the valley, and this may have resulted from the simultaneous control of domestic insects such as flies and cockroaches by the DDT deposits.

Anduze (P. J.). **Notas entomológicas I. Dos variedades nuevas de** *A. aquasalis*. [Entomological Notes I. Two new Varieties of *Anopheles aquasalis*.]—*Bol. méd. Creole Petrol. Corp.* **1** no. 1 pp. 17–19. Caracas, 1948.

This is the first of an intended series of notes on insects that occur in and near the oilfields of the Creole Petroleum Corporation in Venezuela. In it, the author gives characters of the adults, mainly the coloration of the legs, distinguishing two melanic varieties of *Anopheles aquasalis* Curry taken at Pedernales, on the north-east coast, from the typical form and from each other. The names var. *guaraúno*, n., and var. *delta*, n., are proposed for them. Eggs obtained from females of both varieties did not differ from those of the typical *aquasalis*. He also lists three other American species of *Anopheles* that are known to have melanic forms and records *A. bellator* D. & K. breeding in bromeliads, *A. homunculus* Komp. and *Wyeomyia trinidadensis* Theo. from Venezuela.

Mosna (E.). *Culex pipiens autogenicus* **DDT-resistenti e loro controllo con Octa-Klor e esaclorocicloesano.** [DDT-resistant *Culex pipiens autogenicus* and their Control with Chlordan and Benzene Hexachloride.]—*Riv. Parassit.* **9** no. 1 pp. 19–25, 14 refs. Rome, 1948. (With Summaries in French and English.)

The author recapitulates the results of experiments in which it was shown that adults of *Culex pipiens autogenicus* Roub. in Latina were resistant to DDT [*R.A.E.*, B **38** 129] and states that these were carried out as a result of the observation in late May 1947 of numerous apparently unaffected examples on the walls and ceilings of bedrooms treated with 5 per cent. DDT in kerosene, in addition to many dead ones on the floors. In further tests, no better results were given by increasing the deposits of DDT to 4 and 6·3 gm. per sq. metre. When adults taken in untreated premises where larvae were breeding in seepage were confined in a box having glass sides treated with 5 per cent. DDT in kerosene, 60–80 per cent. of them were dead in 2–5 hours, but the remainder were still alive after a further 48 hours. Eight generations were reared from eggs laid by resistant females, and batches of adults of each were exposed in the box to deposits of 0·2 mg. DDT per sq. cm. from an acetone solution. All survived exposures of 24–48 hours, although showing signs of poisoning after about one hour. When similarly exposed to deposits of 0·1 mg. technical chlordan (Okta-Klor) per sq. cm. from acetone solution, adults of the resistant strain introduced at intervals of ten days over a period of four months were all dead in 40–90 minutes. A 5 per cent. solution of technical chlordan in kerosene was applied to the walls and ceiling of a bedroom at Latina to give a deposit of 1 gm. per sq. metre, and no *Culex* were found in it during the next four months, though they had been numerous before treatment, in spite of the previous application of DDT. To study the fumigant effects, cages containing resistant *Culex* adults were placed about a foot away from one of the treated walls every three days for a fortnight after treatment. Complete mortality occurred after 4–6 hours during the first week and after 8–12 hours during the second. A similar test after a month gave a negative result. In a test in which adults of the resistant strain were confined on a wall treated with benzene hexachloride to give a deposit of 0·1 mg. [? per sq. metre], complete mortality was given in 10–15 minutes during the first month, 20–30 during the second and third, and 30–40 during the fourth.

La Face (L.). **Su alcune particolarità del pretarso in** *Musca domestica.* [Some Details of the Praetarsus in *M. domestica.*]—*Riv. Parassit,* **9** no. 1 pp. 27–30, 1 fig., 2 refs. Rome, 1948.

The author describes the praetarsus in *Musca domestica* L. in view of its possible importance in connection with susceptibility and resistance to DDT [*cf. R.A.E.*, B **37** 216–217].

Verolini (F.). **Sul meccanismo di azione del DDT sulle larve di culicine.** [On the Mechanism of Action of DDT on Culicine Larvae.]—*Riv. Parassit.* **9** no. 1 pp. 31–37, 1 fig., 15 refs. Rome, 1948. (With Summaries in French and English.)

In order to discover whether the toxicity of DDT to mosquito larvae is due to ingestion or to contact action, larvae of *Culex pipiens autogenicus* Roub. that had just completed the third moult were ligatured between head and thorax to prevent the ingestion of food and placed in dishes of water to which finely powdered DDT was added at the rate of 1 gm. per 250 cc. The controls consisted of larvae that were not ligatured but were similarly exposed to DDT, and ligatured larvae in water only. The DDT remained partly on the surface of the water and partly on the bottom, the temperature was 20–22°C. [68–71·6°F.], and it was previously shown that larvae subjected to tight ligaturing survived for more than 24 hours without food. Of the 116 larvae in each of the three groups, 70, 86 and 28, respectively, died, and dissection of the dead larvae showed that 11, 86 and 0 contained DDT in the intestine. Some of the larvae in the first group were evidently not ligatured tightly enough to prevent ingestion, but the results as a whole indicated that both stomach and contact action were involved. It can be assumed that the contact action is due to penetration of the cuticle as a result of the lipoid solubility of DDT, but the mechanism of the stomach action is more difficult to explain. The DDT probably reaches the stomach epithelium by being dissolved in the chitinous material forming the peritrophic membrane.

The larvae used were of a strain of *C. p. autogenicus* from Latina of which the adults are resistant to DDT [*cf. R.A.E.*, B **39** 116], but this resistance was evidently not present in the larvae, since high mortalities were obtained in the tests. Of the larvae in the second group, eight pupated ; the pupae were left in the treated water, and all gave rise to adults.

Sforza (M.). **Dermotifo in Eritrea (identificazione dei virus storico, murino e da zecche).** [Typhus in Eritrea (Identification of Historic, Murine and Tick-borne Strains.]—*Boll. Soc. ital. Med.* (*Sez. Eritrea*) **7** no. 5–6 pp. 430–463, 26 refs. Asmara, 1947. (With a Summary in English.)

In connection with outbreaks of typhus in Asmara in 1945 and 1946, the author carried out investigations on the identity of fevers of the typhus group in Eritrea. The work is described in detail, and the following is based on his conclusions from it. Studies were first carried out on three strains from man and one from lice [*Pediculus humanus humanus* L.] taken from native patients, and from the results of clinical and serological observations, the effects of the strains in guineapigs, the morphology of the rickettsiae found, the agglutinins developed in rabbits, and cross-immunity tests in which most of the strains were tested against one another, it is concluded that the strain from lice was of the ordinary louse-borne type, and that the strains from man were, respectively, louse-borne and murine typhus and an indeterminate strain thought to be tick-borne. In further work, strains were isolated from *Rhipicephalus sanguineus* (Latr.) from a dog belonging to a patient in Massawa and *R. appendiculatus* Neum.

from that of another in Asmara. They produced similar reactions in guineapigs, dying out after a few passages, and in the case of the second, rickettsiae morphologically resembling those of the indeterminate strain previously studied were found. A small mild outbreak apparently referable to ticks occurred in a transit camp at Ghinda at the end of the rains in 1946, several of the patients presenting eschars. A strain from one of them was established in guineapigs but died out after three passages. Similar strains were recovered from a dog in the neighbourhood of the camp and from *R. sanguineus* taken from it. Two ticks not used for the preparation of suspension were kept for 50 days and then allowed to feed on a healthy guineapig, which subsequently developed the same symptoms as those into which the suspension was injected. The strains from man, dog and ticks are held to represent a single clinical entity, and from the observations on it and cross-immunity tests it is thought to belong to the group of African and Mediterranean tick-borne spotted fevers and to be probably identical with Marseilles fever, though it showed some slight differences from it.

MARA (L.). **Studio morfologico dell'uovo di** *Anopheles dancalicus* **(Corr. 1939).** [Morphological Study of the Egg of *A. dancalicus*.]—*Boll. Soc. ital. Med. (Sez. Eritrea)* **8** no. 1–2 pp. 76–83, 4 figs., 11 refs. Asmara, 1948. (With a Summary in English.)

The author gives a detailed account of the morphology of the hitherto undescribed egg of *Anopheles dancalicus* Corradetti, based on material laid by females taken near Massawa, Eritrea [*cf. R.A.E.*, B **36** 97]. The eggs of this species lack lateral floats, which may be an adaptation to the buoyancy of the salt water in which it breeds [*cf.* **28** 62].

SACKTOR (B.). **A Comparison of the Cytochrome Oxidase Activity of two Strains of House Flies.**—*J. econ. Ent.* **43** no. 6 pp. 832–838, 4 figs., 22 refs. Menasha, Wis., 1950.

Following his finding (reported in an unpublished thesis) that DDT and methoxy-DDT inhibit the respiratory enzyme, cytochrome oxidase, of mammalian heart tissue and of house-flies [*Musca domestica* L.], the author studied the cytochrome oxidase activity of house-flies of a normal strain and of the Ellenville DDT-resistant line [*R.A.E.*, B **38** 87, 134]. A spectrophotometric technique was used.

The following is substantially his summary of the work. The cytochrome oxidase activity of the flies was not constant throughout adult life. There were increases of over 50 per cent. within the first two hours of emergence and over 100 per cent. within one day, and a further slight increase on the second day. Subsequently, this high level was generally maintained in the normal strain. In the resistant strain, it decreased and then rose again to a small extent. On a weight basis, there was greater oxidase activity at a given age for males than for females in the normal strain. It was about the same for the sexes in the resistant strain. The resistant strain had a greater oxidase activity than did the normal strain. The average increases in activity for all ages over the normal strain were 64 and 36 per cent. for females and males, respectively.

It is suggested that one of the explanations for resistance in house-flies to DDT may be a greater cytochrome oxidase activity in the resistant flies, though other factors are apparently also involved. The relation between the cytochrome oxidase activity of flies of the resistant strain at different ages and the susceptibility of the flies to DDT is discussed.

Morrison (H. E.), Lauderdale (R. W.), Crowell (H. H.) & Mote (D. C.). **Space Spraying for Fly Control in Dairy Barns.**—*J. econ. Ent.* **43** no. 6 pp. 846–850, 2 refs. Menasha, Wis., 1950.

A spray of DDT to leave a toxic deposit was applied to the outside of dairy barns at Oregon State College in 1949 and sprays of 10 per cent. chlordan for the same purpose to the manure pit in 1948 and 1949, but only space sprays were used inside the barns during 1945–49. Work in each of these years is briefly reviewed. The sprays used were 5 per cent. DDT in 1945–47, 10 per cent. chlordan in 1948 and pyrenone concentrate R.E. 50–5 (50 gm. technical piperonyl butoxide, 5 gm. pyrethrins and ultrasene to make 100 ml.) diluted 1 : 49 in deobase oil in 1949. Control of the house-fly [*Musca domestica* L.] and *Siphona irritans* (L.) was satisfactory, but it was necessary to apply the spray over the cows in the barn to control the latter. The stable fly [*Stomoxys calcitrans* (L.)] became troublesome for the first time in 1949 and was readily killed but not effectively controlled by the space sprays of pyrenone. There was no indication of the development of insecticide-resistant strains of flies in the dairy barns, possibly because the frequent eradication of the fly population from them left no survivors to perpetuate their line. In contrast, DDT-resistance in house-flies developed after the use of sprays to leave a toxic deposit in the college pig barn. In 1948, 11 space sprays of chlordan were needed to hold the *Siphona* population to 6·8 per cow in a 135-day season, and 17 applications of pyrenone were needed in 1949 to keep it to 8·1 over a 172-day period. The amount of toxicant applied was equivalent to 3·85 gm. chlordan or 0·09 gm. piperonyl butoxide and pyrethrum per cow per treatment. The success of space-spraying depended on early application, and the work indicated that properly timed space sprays would maintain the high standards of fly control now required. The use of any of the three materials is economically practicable, but pyrenone sprays may have some advantage, as they do not appear to contaminate milk. A list is given of 40 species of flies from the barns that were identified in 1948. *M. domestica*, which had been predominant in 1945, was not present in 1948.

Claborn (H. V.), Beckman (H. F.) & Wells (R. W.). **Excretion of DDT and TDE in Milk from Cows treated with these Insecticides.**—*J. econ. Ent.* **43** no. 6 pp. 850–852, 4 refs. Menasha, Wis., 1950.

In conjunction with experiments near Kerrville, Texas, in 1948 on different methods of spraying dairy cattle for the control of *Siphona irritans* (L.) [*R.A.E.*, B **38** 117], observations were also made on the extent to which milk was contaminated when dairy barns and cows were sprayed with DDT or 1,1-dichloro-2,2-bis(parachlorophenyl)ethane [DDD] in emulsion concentrates diluted to contain 0·5 per cent. insecticide. Four dairy herds were treated with DDT and three with DDD, and at the beginning of the tests and sometimes subsequently during the season, all barns were treated for the control of *Musca domestica* L. with 5 per cent. sprays of the same insecticides as were used on the cattle. Composite milk samples were taken from each herd weekly throughout the summer, and analysed colorimetrically [**38** 136]. The results of all analyses are given in tables.

All the treated herds excreted DDT or DDD in milk throughout the season, the average amounts ranging from 0·14 to 0·33 part per million in different herds. Individual treatments of the cows with DDT caused more insecticide to appear in milk than did similar treatments with DDD, but as DDD was applied more often to give the same degree of control, the average contamination

for the season was about the same for the two insecticides. Single applications of 2 U.S. quarts spray caused more contamination than single applications of 1 U.S. quart. In some instances, treatment of the barns caused an increase in the insecticide content of the milk.

HANSENS (E. J.). **House Fly Control in Dairy Barns.**—*J. econ. Ent.* **43** no. 6 pp. 852–858, 4 refs. Menasha, Wis., 1950.

On account of the development of resistance to DDT in house-flies [*Musca domestica* L.] in New Jersey [*R.A.E.*, B **38** 4] and the recommendation that DDT should not be used in dairy barns or on dairy cattle [**39** 7], several insecticides were compared with it in 1949 as sprays to leave toxic deposits for the control of flies in barns. Watering cups, feed troughs and feed were covered before spraying, which was continued to the point of run-off and repeated as often as was necessary to keep flies under control. The results, which are summarised in tables, were assessed in the barns by visual observation and by exposing caged flies of a normal and a DDT-resistant strain (Ellenville) [**38** 87] on sprayed walls for known periods, and in the laboratory by exposing flies to plywood panels sprayed in the barns at the time of treatment.

Early in the season, DDT gave adequate control for about two months, but later it failed in the same barns within two weeks of application. This was found to be due to resistance in the flies. A water-paint formulation (5 per cent. DDT in clay base at 180 lb. per 100 U.S. gals.) was effective for two weeks less than a 50 per cent. wettable powder, which was used at 20 or 40 lb. Methyl-DDT (ditolyl trichloroethane) as a 50 per cent. wettable powder was tried in two barns at 20 lb. per 100 U.S. gals. and gave good initial kill, but within a week of treatment flies were as abundant as before. Methoxy-DDT (methoxychlor) applied in two barns as a wettable powder (40 lb. 50 per cent. powder per 100 U.S. gals.) gave control for 4–6 weeks, but 8 gals. of a 25 per cent. emulsion concentrate per 100 gals. spray was effective for less than two weeks. When methoxy-DDT was applied soon after whitewash, its effectiveness was reduced. Lindane [at least 99 per cent. γ benzene hexachloride], applied at concentrations of 8 lb. 25 per cent. wettable powder or 5 U.S. quarts 20 per cent. emulsion concentrate per 100 U.S. gals., gave excellent control for a month, and control of DDT-resistant flies was very good. The emulsion was easier to apply and remained effective for slightly longer than the wettable powder. Lindane disappeared rapidly from sprayed surfaces after two weeks. In preliminary tests, small amounts of concentrate diluted 1 : 24 and applied from hand sprayers gave excellent results. Chlordan (20 lb. 50 per cent. wettable powder per 100 U.S. gals.) generally gave control for 4–6 weeks [*cf.* **39** 61] but was somewhat variable in its effect and killed rather slowly. Dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] kept populations down for about a month when applied either at 8 or 20 lb. 25 per cent. wettable powder per 100 U.S. gals., but like chlordan it killed slowly. The results of the laboratory tests in general confirmed those obtained in the field, but the insecticides remained effective for longer on the panels than on walls in barns.

Analysis of milk from cows housed in barns sprayed with methoxy-DDT and chlordan showed no contamination with these materials. Similar results have been reported with DDT and lindane [*cf.* **39** 59]. Of the insecticides tested, methoxy-DDT and lindane were the most satisfactory and will be recommended for use in dairy barns.

Laake (E. W.), Howell (D. E.), Dahm (P. A.), Stone (P. C.) & Cuff (R. L.). **Relative Effectiveness of various Insecticides for Control of House Flies in Dairy Barns and Horn Flies on Cattle.**—*J. econ. Ent.* **43** no. 6 pp. 858–861, 1 ref. Menasha, Wis., 1950.

Since the U.S. Food and Drug Administration considers that methoxy-DDT (methoxychlor) and pyrethrum can be used to treat cows or dairy barns as they involve no risk of milk contamination and toxicological studies have indicated that lindane [at least 99 per cent. γ benzene hexachloride] and toxaphene are also safe for these purposes, investigations were made during 1949 in Oklahoma, Missouri and Kansas on the value of these as substitutes for DDT in the control of flies [*cf. R.A.E.*, B **39** 7]. Methoxy-DDT was used as a wettable powder, and the others in emulsified sprays. The Scudder fly-grill [**38** 158] was used to measure populations of *Musca domestica* L. in barns. The density of *Siphona irritans* (L.) on cattle was estimated immediately before the first application and several times subsequently. In treating barns, the inside and outside walls and the ceiling were thoroughly sprayed, but not the floor, stanchions or food and drink containers.

The average protection period against *M. domestica* in barns and (in brackets) the range of the period of protection, both in days, were 15 (1·5–63) for 1 per cent. methoxy-DDT, 14·4 (1·5–57) for 1 per cent. toxaphene, 17·1 (1–56) for 0·25 per cent. lindane and 6·6 (1·5–29) for 0·1 per cent. pyrethrum with 1 per cent. piperonyl butoxide. Sanitation in and about the barns greatly influenced the results. It also appeared that, in some barns, the flies were showing resistance to the insecticide used. Applied to dairy cattle for the control of *S. irritans* by covering the whole animal with 2 U.S. quarts spray, 0·5 per cent. methoxy-DDT protected for 17·8 (8·5–41) days, 0·5 per cent. toxaphene for 18·7 (8·5–43·5), 0·025 per cent. lindane for 14·3 (2·5–49), and 0·05 per cent. pyrethrum with 0·5 per cent. piperonyl butoxide for 6·8 (4–10). The corresponding figures when the same sprays were applied to beef cattle in Kansas were 38·8 (25–60), 27·6 (16–45), 18·2 (9–34) and 11·8 (4–19). The beef herds were isolated from untreated cattle, whereas the dairy cattle were not.

Collins (D. L.) & Nardy (R. V.). **Effects of DDT Spray Residues on Larvae of the Tick *Dermacentor variabilis*, Say.**—*J. econ. Ent.* **43** no. 6 pp. 861–863, 1 ref. Menasha, Wis., 1950.

A prolonged absence of reinfestation in some experiments in New York in which DDT sprays were applied to plots and strips of roadside for the control of *Dermacentor variabilis* (Say) [*R.A.E.*, B **37** 204] and even a noticeable contrast between sprayed and adjacent unsprayed areas in the following season suggested that deposits from the spray might have affected the young ticks that hatched in the treated area. Studies were therefore made on the effects of DDT deposits from emulsified solutions on larvae before they attach.

Tests in 1948 strongly indicated that at least 5 lb. DDT per acre was needed to affect larvae exposed for 24 hours three weeks after treatment. With 1 or 2 lb., mortality was extremely variable after two weeks and averaged only about the same as in the controls. In more extensive experiments in 1949, the first examinations were made after shorter periods. A dosage of 1 lb. per acre remained highly effective for a few hours but became relatively ineffective by the end of a week. Dosages of 5 and 7 lb. were both effective for five weeks though they had begun to deteriorate after four. Dosages of 10 and 20 lb. were still causing fair to good mortality six weeks after application, when the tests ended, though effectiveness had apparently begun to decline after five weeks.

It is concluded that DDT applied locally at 5 lb. or more per acre for the direct control of adult ticks may possibly limit reinfestation by killing larvae that hatch after spraying either from eggs laid before treatment or from eggs laid by engorged ticks that drop from animals visiting the treated area.

TEOTIA (T. P. S.) & DAHM (P. A.). **The Effect of Temperature, Humidity, and Weathering on the residual Toxicities to the House Fly of five organic Insecticides.**—*J. econ. Ent.* **43** no. 6 pp. 864–876, 8 figs., 22 refs. Menasha, Wis., 1950.

The following is based on the authors' summary. Comparative evaluations of deposits of aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene], chlordan, dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene], lindane [containing at least 99 per cent. γ benzene hexachloride] and parathion, were made by laboratory tests on house-flies (*Musca domestica* L.). Benzene solutions were used in the first experiment, to determine the median lethal dose, and emulsified solutions in the second and third, which concerned, respectively, the effect of weathering and the effect of temperature and humidity on deposits. Some commercial emulsion concentrates were used, and the exact composition of these was not known, but of the toxicants used in preparing concentrates in the laboratory, aldrin and dieldrin were recrystallized, technical chlordan was of a refined grade, and technical parathion contained 98·2 per cent. parathion. Methods used are described.

The average median lethal dosages of recrystallised aldrin, chlordan, recrystallised dieldrin, lindane and parathion determined on the basis of 1 gm. flies exposed by a biological assay method [*R.A.E.*, A **38** 373] were 2·2, 9·66, 1·35, 3·61 and 4·04 mmg. toxicant deposit, respectively. The average slopes of regression of probit mortality on dosage were 0·624, 0·137, 1·415, 0·533 and 0·476, respectively, indicating that the average increase in probit mortality per unit increase in amount of toxicant was greater for dieldrin than for the other materials.

In the second and third experiments, commercial and laboratory preparations of the five insecticides were compared on the basis of 50 mg. toxicant per sq. ft. In the second, they were applied on unpainted, painted and whitewashed plywood panels and exposed to all outside elements of weather. Of the commercial preparations, lindane was initially the most rapidly toxic in action, aldrin and dieldrin came next and were about equal, followed closely by parathion, and chlordan was the least toxic. The dieldrin formulations tested were the most persistent under outdoor conditions, retaining about 50 per cent. of their initial toxicity after 45 days on the three types of panels. The toxicity of the others fell by 50 per cent. in ten days. In general, the order of decreasing persistence of the five insecticides on wooden panels, over the period of 45 days, was dieldrin, aldrin, parathion, chlordan and lindane. All were most persistently toxic on unpainted wood. On whitewashed wood, the toxicity of aldrin and dieldrin lasted about as well as on unpainted wood, but the toxicity of chlordan, lindane and parathion declined more rapidly than on unpainted or painted wood. Painted wood, in general, was intermediate in the maintenance of toxicity, except that dieldrin showed lower toxicity than on the other surfaces. The laboratory emulsions had rather low initial toxicity, but lost effectiveness more slowly than the commercial emulsions, and in the case of dieldrin, toxicity increased with increasing age up to 23 days.

In the third experiment, the emulsions were compared on glass panels, and all were highly toxic initially, exposure for one minute producing complete mortality in 24 hours. Twelve hours after treatment, parathion gave the most rapid knockdown, followed by lindane, aldrin, dieldrin and chlordan. After

two days, aldrin and dieldrin had changed places. High temperature and low relative humidity together reduced the duration of effectiveness more than did low temperature and high relative humidity. When kept at 108±2°F. and 36±5 per cent. relative humidity, deposits of aldrin, chlordan and lindane from commercial emulsions produced insignificant mortalities even on the fourth day. Dieldrin and parathion had deteriorated to about the same extent by the 16th day. When laboratory emulsions were used, the toxicity of the deposits of the five insecticides was slightly extended, and the order of decreasing toxicity was dieldrin, parathion, chlordan, aldrin and lindane. At 82±2°F. and 58±5 per cent. relative humidity, the commercial emulsions containing aldrin, chlordan and lindane maintained high toxicities on the fourth day but gave virtually no kill on the 16th, parathion gave 92 per cent. mortality after 28 days but none after 52, and dieldrin was still giving 46 per cent. mortality after 52 days. The laboratory emulsions had slightly longer periods of effectiveness in most cases. At 52±2°F. and 76±5 per cent. relative humidity, both commercial and laboratory emulsions containing dieldrin and parathion were unusually persistent and gave complete mortalities throughout the 65 days for which observations were made. Aldrin, chlordan and lindane produced high mortalities for 16 days, but showed an evident decline in toxicity after 28 days. The order of decreasing persistence was lindane, aldrin and chlordan for the commercial emulsions, and chlordan, lindane and aldrin for the laboratory emulsions. The initial toxicity resulting from the use of the commercial solvent (Velsicol AR-60) or xylene with the emulsifying agent (Triton X-100) in the absence of toxicants was fairly high (19–24 per cent.) on glass panels, but was low (3–6 per cent.) on wood.

Roth (A. R.) & Mote (D. C.). **DDT-resistant Flies in Oregon.**—*J. econ. Ent.* **43** no. 6 p. 937. Menasha, Wis., 1950.

A pig barn at Oregon State College in which DDT had been used in 1944, 1945 and 1947 and BHC (benzene hexachloride) in 1946 was sprayed with DDT in June 1949 and with a mixture of DDT and chlordan in August. Control of *Musca domestica* L. was poor in August and September, and an experimental strain of flies (Corvallis strain) was reared from adults collected in the barn on 29th September. Exposure for ten minutes to a deposit of 10 mg. DDT per sq. ft. caused no mortality of F_1 Corvallis adults in 24 hours, whereas it caused 92 per cent. mortality in flies of a regular strain. Continuous exposure knocked down all flies of the regular colony in 63 minutes and only 96 per cent. of the Corvallis flies in 24 hours. The mortalities in 24 hours of flies of the regular strain and of F_3 and F_7 adults of the Corvallis strain exposed to DDT deposits are given in a table and show that the resistance of the Corvallis strain was high, but was lower in the seventh than in the third generation. Thus, with ten minutes' exposure, a deposit of 160 mg. per sq. ft. killed only 79 and 95 per cent. of the F_3 and F_7 flies, whereas 2·5 and 20 mg. killed 85 and 98 per cent. of the corresponding controls. With a deposit of 10 mg., exposure for 80 minutes killed 84 and 93 per cent. of the F_3 and F_7 Corvallis flies, but contact for 0·625 minute killed 93 and 98 per cent. of the respective controls.

Exposure of F_3 and F_8 Corvallis flies to chlordan deposits indicated that they were, in general, somewhat more susceptible than control flies, though the converse was true in one test with the F_3 generation. Exposure for ten minutes to lindane [at least 99 per cent. γ BHC] at 0·062 and 0·5 mg. per sq. ft. killed 55 and 100 per cent. of the Corvallis flies and only 31 and 63 per cent. of the controls.

Reports indicate that DDT-resistant strains are not generally distributed in Oregon.

YATES (W. W.). **Comparative Resistance of different Instars of *Aëdes* Mosquitoes to chlorinated Hydrocarbon Insecticides.**—*J. econ. Ent.* **43** no. 6 pp. 944–945, 3 refs. Menasha, Wis., 1950.

In 1949, DDT, DDD (TDE [dichlorodiphenyldichloroethane]) and toxaphene were tested in Oregon against larvae of floodwater species of *Aëdes* in different instars. About 95 per cent. of the mosquitos were *A. sticticus* (Mg.) and 5 per cent. *A. vexans* (Mg.), the chief pest species of the Lower Columbia River Valley. DDT and toxaphene were also tested against *A. dorsalis* (Mg.), an important pest species of irrigated and coastal areas. Larvae were obtained by flooding pans of soil from untreated breeding areas with lukewarm water, and were kept at 80°F. For testing, acetone solutions of the three insecticides were added to tap water and larvae introduced.

The average kills of the different instars in 48 hours are shown in a table. DDD was less effective than DDT but much more effective than toxaphene. *A. dorsalis* needed higher concentrations of DDT than did the floodwater species for equivalent kills. A concentration of 0·001 part per million killed 97 per cent. of first-instar larvae of the floodwater species and only 22 per cent. of those of *A. dorsalis*. Of fourth instars, kills by 0·005 p.p.m. were 71 and 49 per cent., respectively. Results against the two types of mosquitos were more equal with toxaphene. The concentrations needed for equivalent kills with all the chemicals increased as the larvae developed, but differences in susceptibility were more pronounced between the second and third instars than between the first and second or third and fourth. DDT killed 97–99 per cent. of the successive instars of the floodwater species at 0·001, 0.00125, 0·005 and 0·01 p.p.m., respectively. DDD killed 95, 98, 81 and 76 per cent. of first, second, third and fourth instars at 0·00167, 0·005, 0·01 and 0·01 p.p.m., respectively. Toxaphene was about as toxic to second as to first instars of both types of mosquitos, but never gave very high kills, except that 0·005 p.p.m. killed 96 per cent. of second instars of the floodwater species. DDT was about equally toxic to the first and second instars of *A. dorsalis*, and the difference in the concentration required to kill first and fourth instars was less than for the floodwater species. It killed 81 and 64 per cent. of the first and second instars at 0·00167 p.p.m. and 95 and 63 per cent. of the third and fourth at 0·01 p.p.m. These results show the advantage of treating breeding areas when the larvae are young or before they have hatched [*R.A.E.*, B **38** 116].

AITKEN (T. H. G.). **Recovery of Anopheline Eggs from natural Habitats, an Aid to rapid Survey Work.**—*Ann. ent. Soc. Amer.* **41** no. 3 pp. 327–329, 3 refs. Columbus, Ohio, 1948.

There are several complexes in the genus *Anopheles* the members of which can be separated only by examination of the eggs. In making surveys where they are likely to occur, the usual practice has been to collect females and keep them until they oviposit. This is troublesome and slow and often results in a far less complete survey than could be made by direct collection of eggs, particularly in areas of scattered population where man-made shelters for house-haunting species are few and adults consequently hard to find. Methods have been devised for stranding eggs on cloth through which the water drains away [*cf. R.A.E.*, B **23** 202], but much débris is also retained and separation of the eggs is sometimes difficult. Working in Sardinia in 1946, the author found that it was possible to detect the eggs floating on the water in the dipper, remove them with a piece of straw, make a tentative identification with a hand lens, and then transfer them to blotting paper soaked in 2 per cent. formalin and store them on the blotting paper in glass vials. The top of the paper was bent over to keep the eggs from contact with the glass. Eggs were found in this

way in 442 of 546 dipping stations in which larvae were taken. Four Anophelines (*A. maculipennis* Mg. vars. *labranchiae* Flni. and *melanoon* Hackett, *A. claviger* (Mg.) and *A. algeriensis* Theo.) were identified from the eggs, and only one uncommon species (*A. marteri* Sen. & Prun.) found in other stages was not represented in the egg collections. Incidence as determined largely from eggs was confirmed in more extensive studies in the following year.

Bruce (W. N.). **Studies on the biological Requirements of the Cat Flea.**—*Ann. ent. Soc. Amer.* **41** no. 3 pp. 346–352, 9 refs. Columbus, Ohio, 1948.

The food requirements of larvae of *Ctenocephalides felis* (Bch.) and the most favourable conditions for growth and survival were studied with a view to developing a standardised rearing procedure. Eggs were procured from a large sheet of paper placed beneath the hardware cloth floor of a cage containing two cats. They were sifted to remove débris and incubated for 24 hours. The developing embryo could then be detected with a binocular microscope, and 100 viable eggs were transferred by means of an aspirator to each petri dish used in the observations. The affecting variables studied were quantity of dried blood, quantity of sand used as substrate, amount of dried brewer's yeast, effect of crowding, diameter of rearing dish, temperature, humidity, food materials, essential dietary components and synthetic diets.

The best growth and survival were obtained when larvae from 100 viable eggs were reared in a medium consisting of 1 gm. dried ox blood, 50 mg. brewer's yeast and 4 gm. clean sand in a 5–10 cm. petri dish, and kept at a temperature of 80 or 90°F. with a relative humidity of 65–90 per cent.

Bick (G. H.). **Resistance of *Culex quinquefasciatus* Say Larvae and Pupae to experimental Drought.**—*Ann. ent. Soc. Amer.* **41** no. 3 pp. 360–368, 42 refs. Columbus, Ohio, 1948.

The author gives references in the literature to the sex ratio of newly emerged mosquitos and the resistance of the aquatic stages to drought, recalls that in a previous study, he and Penn investigated the resistance of larvae of three species of mosquitos to drought but did not pursue their observations on survival until adult emergence [*R.A.E.*, B **37** 181], and describes observations on the resistance of larvae and pupae of *Culex fatigans* Wied. (*quinquefasciatus* auct.) to various periods of experimental drying and the effect on the production of adults. *C. fatigans* generally breeds in shallow collections of polluted water, which would probably be reduced to a condition of damp mud at intervals during almost any season. Fourth-instar larvae and pupae were collected in Mississippi in 1947 and subjected to controlled conditions believed to simulate those in pools.

When 362 larvae were kept on damp filter paper in covered petri dishes for 24, 48, 72 or 96 hours (at least 75 for each period) and then flooded, the four periods of drying resulted in reductions of survival immediately after treatment of 17·3, 60·5, 89·4 and 94·7 per cent., respectively, as compared with the controls. In 64 per cent. of 202 dead larvae of experimental batches examined microscopically, internal changes preliminary to pupation were well advanced. Mortality among controls was not concentrated in the prepupal period in this way. The percentage reductions in the numbers of adults produced were 44·6, 79·3, 96 and 99, respectively. Of 298 pupae maintained under continuous drought conditions, 97·9 per cent. produced adults, as compared with 99·1 per cent. in the controls. The sex ratio among the 414 adults that emerged in the experiments on pupae was 1 : 1, with very little difference between experimental and control pupae.

YEAGER (J. F.) & MUNSON (S. C.). **A Ratio Hypothesis pertaining to the biological Action of Poisons and Drugs.**—*Ann. ent. Soc. Amer.* **41** no. 3 pp. 377–383, 3 graphs, 4 refs. Columbus, Ohio, 1948.

The authors give a more precise statement of the general form of a hypothesis presented in a paper already noticed [*R.A.E.*, B **37** 52] to explain the relationship found to exist between the concentration of poison administered and the survival time of cockroaches into which sodium-metarsenite solution has been injected. It is based on the assumption that the metarsenite solution contains two forms of chemical, only one of which is insecticidal, and that the ratio of the two varies with the concentration of the solution. An equation relating the concentration of active fraction to total concentration is calculated.

As present concepts of physical chemistry indicate that the sodium metarsenite must be considered to be completely ionised within the concentration range used, the physicochemical interpretation formerly offered, that only some of the molecules were ionised to free the toxic arsenite ion [*cf.* **33** 25 ; **35** 50 ; **37** 62], is discarded in favour of one based on a hydrolysis equilibrium. According to this, at or below a critical concentration, all the arsenite ions or a constant proportion of them in buffered body fluid are hydrolysed into molecules of arsenious acid that ionise to a slight degree, whereas as the concentration increases above this level in a less buffered or unbuffered body fluid the proportion hydrolysed and un-ionised decreases to a minimum. The arsenite ions are considered to be the nontoxic form of the poison and the arsenious acid molecules the toxic form.

BOTT (R.). **Der Einfluss des Kontaktstoffes "Gix" auf den Körper des Schädlings.** [The Effect of the Contact Substance "Gix" on the Body of the Pest.]—*Anz. Schädlingsk.* **21** pt. 6 pp. 91–95, 4 figs. Berlin, 1948.

An account is given of investigations on the mode of action on arthropods of Gix (a proprietary emulsion concentrate [of fluoro-DDT]). It proved toxic to adult mosquitos (*Aëdes aegypti* (L.)) in a cage suspended 1 cm. above a piece of carboard impregnated with the emulsion, though considerable time was required for mortality, and also to mosquito larvae in water into which it was introduced in two ways that prevented actual contact with the droplets. The author concludes that its effect was exercised by way of the body surface, the stomach or tracheal system playing no part. DDT has been considered to act through sense-organs on the tarsi, but mosquito larvae have no legs and adult flies (including *Musca domestica* L., *Calliphora vomitoria* (L.) and *C. erythrocephala* (Mg.)) that had their legs embedded in paraffin wax so that they were unable to clean themselves died when droplets of the dilute emulsion were applied to various sites on the thorax and abdomen, while control insects remained active. DDT has also been considered to enter the body through the chitin of the cuticle by virtue of its lipoid solubility, but when a tube that contained dilute Gix emulsion and was closed at the end with chitin from the wings of beetles or dragonflies was suspended in water, mosquito larvae in the latter were not affected, and when a *Dytiscus* was killed by adding Gix to the water in which it was kept and then carefully washed with water, after which its body fluid was added to water containing mosquito larvae, none of the latter died, indicating that the Gix had not entered its body.

When mosquitos that had been killed by Gix without actual contact were examined under the microscope, patches of moisture were observed on their legs or on the side of the tube where they had rested. To investigate the nature of this, various arthropods or their extremities were placed in concentrated

Gix emulsion and observed. It was found that several layers of bubbles appeared on the surface immersed, some of them clearly emanating from the pores, followed by an exudation of a material resembling protoplasm, which appeared to emanate from the neighbourhood of the joints. Similar, though less easily visible, phenomena followed immersion in a weak emulsion, and the appearance of the preliminary layer of bubbles followed immersion in dilute Canada balsam or cedar-wood oil, so that it may be connected with the presence of water. Insects that are covered with a wax layer, such as *Eriosoma* (*Schizoneura*) *lanuginosum* (Htg.), were not affected even by contact for several days with a Gix deposit and showed no exudation of body substance, and certain Dipterous larvae that live on salted animal skins and presumably lack the requisite pores were also unaffected. Susceptibility to Gix, therefore, appeared to be related to the frequency of the pores.

LaForge (F. B.), Green (N.) & Gersdorff (W. A.). **Constituents of Pyrethrum Flowers. XXII. Synthesis and relative Toxicity of two Isomers of Cinerin I.** —*J. Amer. chem. Soc.* **70** pp. 3707–3711, 17 refs. Easton, Pa., 1948.

The following is based on the authors' summary. The synthesis of the chrysanthemum monocarboxylic acid esters of 2-(2-butenyl)-5-hydroxy-3-methyl-2-cyclopentene-1-one and of 2-(3-butenyl)-5-hydroxy-3-methyl-2-cyclopentene-1-one is described [*cf. R.A.E.*, B **38** 103]. The results of toxicity tests on house-flies (*Musca domestica* L.) show that the ester of the 2-butenyl-4-hydroxy ketone, natural cinerin I, is about eight times as toxic as the ester of the 2-butenyl-5-hydroxy ketone, and that the ester of the 3-butenyl-5-hydroxy ketone is only slightly more toxic than the latter. The position of the ester group on the cyclopentenone nucleus is therefore of greater importance from the standpoint of insecticidal activity than the position of the double bond in the side chain.

Cupples (H. L.). **Infrared Spectra of Cinerolone and synthetic *trans*-2-(2-Butenyl)-4-hydroxy-3-methyl-2-cyclopenten-1-one.**—*J. Amer. chem. Soc.* **72** pp. 4522–4523, 1 graph, 11 refs. Easton, Pa., 1950.

The chrysanthemum acid esters of pyrethrolone and cinerolone constitute the principal insecticidal constituents of pyrethrum flowers, and when cinerolone is re-esterified with *d-trans*-chrysanthemum monocarboxylic acid, the resulting cinerin I is of about the same order of toxicity as pyrethrin I, with the added advantage of greater stability [*cf. R.A.E.*, B **38** 103]. A series of cyclopentenolones closely related to cinerolone has been prepared, which with synthetic or natural chrysanthemum monocarboxylic acids yield esters with a high order of insecticidal activity, and knockdown and paralytic effects characteristic of pyrethrum extracts. Infrared spectra of natural cinerolone and one of these, synthetic 2-(2-butenyl)-4-hydroxy-3-methyl-2-cyclopenten-1-one, over wavelengths of 2–15 microns showed that the compounds are *cis-trans* isomers and that the naturally occurring compound is the *cis* form and the synthetic compound the *trans* form.

Romaña (C.). **Profilaxis de la enfermedad de Chagas (ideas generales sobre el tema).** The Prevention of Chagas' Disease (General Ideas on the Subject).]—*Bol. Ofic. sanit. panamér.* **26** no. 11–12 pp. 936–942. Washington, D.C., 1947. (With a Summary in English.)

The author points out that the only known method of eliminating Chagas' disease (caused by *Trypanosoma* (*Schizotrypanum*) *cruzi*) in man in South

America is to control the Triatomine bugs that serve as the vectors. Many Triatomines have no contact with man, but some have become partly adapted to living in human habitations, such as *Triatoma infestans* (Klug), which is the chief vector in Argentina, Chile, Uruguay, Paraguay and southern Brazil, and a few have become wholly so, such as *Panstrongylus megistus* (Burm.), which transmits the disease in Brazil. Rural habitations in these countries are primitive, and the bugs shelter in and under furniture and in the numerous cracks in the walls. Recent laboratory tests showed that the bugs were rapidly killed by contact with a dust containing BHC (benzene hexachloride), which proved more effective than DDT, arsenicals or pyrethrum products. Smoke generators were subsequently prepared from a mixture of BHC, sulphur and ammonium nitrate wrapped in damp-proof paper. These burned for about a minute, and the smoke was very toxic to the bugs. In a closed dwelling, the smoke settled on all surfaces, penetrated into cracks and gave almost complete mortality of Triatomines and other household pests in a few days. The deposit remained toxic for about a week. Such generators therefore offer a promising means of control, but the author emphasises that the problem should really be envisaged as one requiring an improvement in rural housing conditions.

Papers noticed by Title only.

Dormal (S.), Delvaux (E. L.), Dills (L. E.) & Frear (D. E. H.). **Synthesis of chlorinated aromatic Compounds, chemical Structure and insecticidal Efficiency.**—*J. econ. Ent.* **43** no. 6 pp. 915–918, 4 graphs, 1 ref. Menasha, Wis., 1950. [See *R.A.E.*, A **39** 245.]

Kenaga (E. E.). **The Relationship of molecular Weight** [of heterogeneous organic compounds] **to insecticidal Activity.**—*J. econ. Ent.* **43** no. 6 pp. 938–939, 1 ref. Menasha, Wis., 1950. [See *R.A.E.*, A **39** 247.]

Hurtig (H.) & Perry (A. S.). **Slide Coatings for Aerosol Droplet Collection and Preservation.**—*J. econ. Ent.* **43** no. 6 pp. 952–954, 2 figs., 6 refs. Menasha, Wis., 1950. [See *R.A.E.*, A **39** 252.]

Simões Barbosa (F. A.). *Culicoides* (**Diptera : Heleidae**) **da região neotrópica** [revision with descriptions of six new species].—*An. Soc. Biol. Pernambuco* **7** no. 1 pp. 3–30, 9 pls. Recife, 1947.

Davis (D. H. S.). **Sylvatic Plague in South Africa : History of Plague in Man, 1919–43.**—*Ann. trop. Med. Parasit.* **42** no. 2 pp. 207–217, 6 figs., 7 refs. Liverpool, 1948.

Chow (C. Y.) & Huang (T. C.). **The Identification of known Species of Taiwan (Formosan) Fleas (Insecta, Siphonaptera).**—*Quart. J. Taiwan Mus.* **3** no. 3 pp. 113–122, 28 figs., 5 refs. Taipei, 1950.

Chow (C. Y.), Huang (T. C.) & Yue (T. F.). **Bibliography of Chinese Arthropods of medical and veterinary Importance.**—*Quart. J. Taiwan Mus.* **3** no. 3 pp. 157–185. Taipei, 1950.

DAVID (W. A. L.) & TEW (R. P.). **Disinsectisation of Aircraft.**—*Mon. Bull. Minist. Hlth* **8** pp. 166–172, 1 pl., 3 refs. London, 1949.

WHITTINGHAM (Sir H.) & GALLEY (R. A. E.). **The Disinsectisation of Aircraft : recent Progress of Work in the United Kingdom and Colonies.**—*T.c.* pp. 186–187.

BUSVINE (J. R.) & TEW (R. P.). **Further Experiments with Aerosols for the Disinsectisation of Aircraft.**—*Op. cit.* **9** pp. 80–87, 3 refs. 1950.

BRUCE-CHWATT (L. J.) & OOI (K. H.). **Aircraft Disinsectisation in West Africa.** —*T.c.* pp. 142–147, 2 refs.

TEW (R. P.), DAVID (W. A. L.) & BUSVINE (J. R.). **Factors affecting the Efficiency of Aircraft Disinsectisation Procedures.**—*Op. cit.* **10** pp. 30–38, 3 refs. 1951.

In the first of these papers, an account is given of the initial investigations to find a substitute for the American " Westinghouse bomb " aerosol dispensers that were used to destroy insects in aircraft of the British Overseas Airways Corporation until supplies became exhausted. The efficiency of commercially available aerosol dispensers of the Westinghouse type and the performance of the Porton-Sparklets lever-controlled aerosol dispenser, in which the propellent is carbon dioxide introduced from a Sparklet bulb, were considered. Tests were made against mosquitos (*Aëdes aegypti* (L.) and *Anopheles maculipennis* Mg.) and house-flies (*Musca domestica* L.) in cages in stationary aircraft. The composition of the solutions used in the various dispensers is given. It was found that the amount of insecticide emitted by dispensers of the American type cannot be accurately measured by timing. The sparklet-type dispenser had a much more uniform performance, and also gave a better kill with a suitable insecticide, such as a combination of pyrethrins and γ BHC (benzene hexachloride), than the commercial dispensers. However, the solution used in it contained methylene chloride, which is injurious to Perspex and therefore unsuitable for use in aircraft. Freon-12 (dichlorodifluoromethane), the propellent gas in the Westinghouse dispenser, though closely related to methylene chloride, does not damage Perspex. The tests showed that the procedure usually followed is often not adequate to kill all mosquitos and flies and that spraying to leave a toxic deposit combined with the regular use of aerosols would be desirable. For this purpose, strongly insecticidal sprays that are not toxic to man or injurious to the materials used in aircraft construction would have to be found.

The second paper contains the results of tests on the effect of four formulae on Perspex. One containing methylene chloride injured it immediately, two containing DDT, pyrethrins and Freon-12 with hydrocarbon oil and polymerised alkylated naphthalenes in one case and with cyclohexanone and lubricating oil in the other caused damage only when the Perspex was at a tension of 2,000 lb. per sq. inch for four days. A heavy film from sesame oil, pyrethrins and Freon-12 did no damage even under these conditions.

Room tests carried out in October and November 1949 with *Aëdes aegypti* and *M. domestica* in cages as the test insects are described in the third paper. It is concluded from them that satisfactory insect control in aircraft would be obtained with a solution of 0·65 per cent. pyrethrins and 0·5 per cent. γ BHC in petroleum ether dispersed by the Porton-Sparklet apparatus at 10 ml. per 1,000 cu. ft. or with a low pressure Freon aerosol bomb [*cf. R.A.E.*, B **38** 205] containing 0·4 per cent. pyrethrins and 3 per cent. DDT or 0·65 per cent. pyrethrins and 0·5 per cent. γ BHC operated for 15 seconds or 10 seconds per 1,000 cu. ft., respectively, with an output of about 1 gm. per second. BHC was slightly more effective than DDT against *M. domestica*, but it had a more pronounced irritant effect on people present during treatment. The inflammability of petroleum ether, the only satisfactory solvent known to

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replace methylene chloride in the Porton-Sparklet apparatus, does not involve a fire hazard at the low rate used in spraying but would be a serious disadvantage in regard to transport in bulk.

The investigations dealt with in the fourth paper were made at Lagos Airport, Nigeria, in February and March 1950 in stationary aircraft in which females of *Anopheles* (*gambiae* Giles and *melas* Theo.) and of *Aëdes aegypti* were exposed in cages. A low-pressure Freon-propelled dispenser containing 0·3 per cent. pyrethrins with the addition of piperonyl butoxide (2 per cent. w/w) in petroleum distillate was found to give rather better knockdown and kill than the Porton-Sparklet dispenser filled with a standard insecticide containing about 0·4 per cent. pyrethrins. At least 0·06 mg. pyrethrins per 1,000 cu. ft. was needed to give adequate control. Females of *Anopheles* were somewhat more sensitive to the tested formulations than those of *Aëdes*. At a dosage of five seconds (or 0·02 gm. pyrethrins) per 1,000 cu. ft., both aerosols gave very erratic knockdown and poor kill of *Aëdes*. At 0·04–0·05 gm. pyrethrins, both gave complete kill of *Anopheles* and 90–100 per cent. kill of *Aëdes* when the ventilating door of the aircraft was kept closed for ten minutes, but the kills were usually lower when it was opened after three minutes, as it had to be when a small aircraft was occupied, owing to the heat and poor ventilation in it. Knockdown and kill of mosquitos in cages near the ventilating door was lower than elsewhere, and the difference was particularly marked when it was opened in three minutes.

As a result of experiments made in 1950 in stationary aircraft in England and described in the fifth paper, in some of which free-flying insects were used, it is recommended that a low-pressure aerosol dispenser containing 0·4 per cent. pyrethrins and 3 per cent. DDT should be used to apply a dosage of 10 gm. per 1,000 cu. ft. When a formula containing piperonyl butoxide was used, knockdown was much improved and so was killing power in the only case in which this could be estimated. The dispenser should not distribute more than 1 gm. per second, as otherwise it is difficult to avoid overtreatment. Doors should be kept closed for at least five minutes. Treatment after luggage has been loaded but before passengers embark is considered most desirable.

Acosta Bayardo (R.). **Informe preliminar acerca de infestación por niguas o *Tunga penetrans* en el Estado de Nayarit.** [Preliminary Note on Infestation by *T. penetrans* in the State of Nayarit.]—*Medicina* **28** no. 558 pp. 251–253. Mexico, D.F., 1948.

In April 1948, 40–95 per cent. of the inhabitants in four settlements in the Mexican State of Nayarit were found to be infested by *Tunga penetrans* (L.). Infestation was in many cases severe, leading to localised or general dermatitis, secondary infections, and, especially in children, general ill-health. The preferred sites were the soles of the feet and the toes, infestation becoming less common higher up the body, though the head, thorax and abdomen were affected in some cases. Infestation was also observed in pigs, dogs and cats. The outbreak appeared to have originated late in 1947, and there was some evidence that it was due to an influx of labourers from the coastal region of Michoacán. Hygienic conditions in the settlements were poor, and adequate clothing and footwear lacking.

Bustamante (M. E.), Varela (G.) & Roch (E.). **Estudio de una nueva fiebre petequial aislada en Michoacán (República Mexicana) del *Rhipicephalus sanguineus*.** [A Study of a new Spotted Fever isolated from *R. sanguineus* in Michoacán, Mexico.]—*Rev. Inst. Salub. Enferm. trop.* **8** no. 3 pp. 163–174, 1 map, 1 graph, 5 refs. Mexico, D.F., 1947. (With a Summary in English.)

The following is based on the authors' summary. In the course of a survey of rickettsial diseases in Mexico, a suspension of a batch of *Rhipicephalus*

sanguineus (Latr.) taken in a house in Morelia, Michoacán, in which a man had died of a spotted fever, proved pathogenic to guineapigs, producing in them a clinical picture resembling Rocky Mountain spotted fever. It is concluded from the presence of rickettsiform elements in the tunica vaginalis of the affected guineapigs and in chick-embryo cultures, the negative results of cross-immunity tests with two strains of murine typhus and two of Rocky Mountain spotted fever (one from man in Sonora [*cf. R.A.E.*, B **38** 125] and the other from *R. sanguineus* in Montemorelos, Nuevo León [*cf.* **38** 126]), and the negative results of complement-fixation tests with epidemic and murine typhus, Rocky Mountain spotted fever and rickettsialpox [**37** 165] that a type of rickettsia is involved that is different from those commonly transmitted by ticks. The name Michoacán fever is suggested for fever caused by it. It is not known whether it occurs in man.

VALLEJO-FREIRE (A.). **Transmissão do virus da febre maculosa mexicana por *Amblyomma striatum* Koch, 1844.** [Transmission of the Agent of Mexican Spotted Fever by *A. striatum*.]—*Mem. Inst. Butantan* **20** pp. 107–112, 9 refs. São Paulo, 1947. (With a Summary in English.)

Since *Amblyomma striatum* Koch has been found naturally infected with spotted fever in São Paulo and has been shown to transmit the infection in the laboratory [*R.A.E.*, B **26** 154–155], its ability to transmit a strain of spotted fever from man in Mexico was investigated. Suspensions of adult males that had engorged on an infected guineapig proved infective when injected into healthy animals. Of two males that began to feed on an infected guineapig but were removed after 20 hours, before the meal was complete, and placed a week later on healthy animals, one failed to feed, but the other completed its meal and the guineapig developed typical symptoms terminating in death. A similar test with an adult female gave a negative result, and the eggs laid by it 20–22 days after the completion of the meal also proved non-infective when a suspension of them was injected, but those laid during the next six days produced typical symptoms in two guineapigs. The female died 44 days after the meal, and though a suspension prepared from it produced no symptoms when injected into two guineapigs, these were subsequently shown to have developed immunity to the homologous strain.

VANDERPLANK (F. L.). **Experiments in cross-breeding Tsetse-flies (*Glossina* Species).**—*Ann. trop. Med. Parasit.* **42** no. 2 pp. 131–152, 2 figs., 23 refs. Liverpool, 1948.

There are various references in the literature to the crossing of *Glossina morsitans* Westw. with *G. swynnertoni* Aust. [*R.A.E.*, B **34** 35; **37** 4, 59, etc.]. An account is here given of experiments on the cross-breeding and attempted cross-breeding of various species and subspecies of *Glossina* made at Shinyanga, Tanganyika, and in a laboratory in England between 1943 and 1947. Pupae for the work were obtained from various parts of Africa. Over 3,000 individuals of 12 species or subspecies were mated, maintained and observed, and the results are shown in a table and discussed.

The following is based on the author's summary. There are varied and numerous barriers against such crossing, most of which have been met with in this work. They are failure to mate, failure to copulate, damage during copulation, failure to inseminate, failure of the sperm to fertilise, and failure of the larvae and pupae to develop. The reciprocal cross is about twice (or only half) as productive as its counterpart. The sterility or partial sterility of hybrids is discussed. Male hybrids obtained by crossing the subspecies of *G. palpalis* (R.D.) are generally unable to mate successfully owing to the morphology of the

genitalia, but are fertile when enabled to do so artificially. The female hybrids are fertile. Male hybrids of the *morsitans* group can copulate and inseminate females but are sterile. The female hybrids are partly sterile, but the percentage sterile depends on the cross. The status of the various subspecies is discussed in the light of the work, and it is concluded that in the main the experiments support the existing classification. The evolution of new species is discussed.

Foy (H.) & others. **Malaria and Blackwater Fever in Macedonia and Thrace in Relation to DDT.**—*Ann. trop. Med. Parasit.* **42** no. 2 pp. 153–172, 5 graphs, 1 map, 20 refs. Liverpool, 1948.

In late 1945 and in 1946, a campaign to control the Anopheline vectors of malaria with DDT was carried out in Greek Macedonia [*cf. R.A.E.*, B **39** 109] and Thrace. A 5 per cent. solution in kerosene was used in houses and a 5 per cent. solution in diesel oil in outhouses and stables to apply about 2 gm. DDT per sq. metre. A 20 per cent. solution in Velsicol was also applied to breeding areas from aeroplanes at 500 cc. per acre. The main vectors in Greece are *Anopheles maculipennis* var. *sacharovi* Favr, which the authors treat as a distinct species and which is most important in the plains, and *A. superpictus* Grassi, which is the more important in mountain areas. Their sporozoite rate is between 1·5 and 3 per cent., though in rare instances it may reach 10 per cent. Other forms of *A. maculipennis* Mg. [*cf.* **36** 39] are abundant in certain areas and can easily be infected in the laboratory, but feed mainly on animals ; the sporozoite rate is only 0·06 per cent.

The results are given of a country-wide malaria survey made in November and December 1946, together with a review of the malaria situation from 1923 until that time, in order to assess the effect of the DDT campaign on the incidence of the disease. Malaria rates in 1945 and 1946 were very low, but were not significantly lower in treated than in untreated areas. They had been falling steadily after a severe epidemic in 1942, and it is concluded that the decline was well established in 1943 and that it is very doubtful if DDT contributed much to its progress. The incidence of blackwater fever was low throughout the period.

Haddow (A. J.), Smithburn (K. C.), Dick (G. W. A.), Kitchen (S. F.) & Lumsden (W. H. R.). **Implication of the Mosquito *Aëdes* (*Stegomyia*) *africanus* Theobald in the Forest Cycle of Yellow Fever in Uganda.**—*Ann. trop. Med. Parasit.* **42** no. 2 pp. 218–223, 10 refs. Liverpool, 1948.

Since 1944, it has been suspected that *Aëdes africanus* (Theo.), an arboreal mosquito, is involved in the transmission of yellow fever among monkeys in Uganda [*R.A.E.*, B **35** 68 ; **37** 150–151, 208]. Points in favour of this view are summarised. In 1945 and 1946, suspensions of many thousand mosquitos taken in forest, including 5,367 examples of *A. africanus*, were injected into laboratory animals without result, and large numbers of rhesus monkeys [*Macaca mulatta*] were caged on platforms in trees in many parts of the forest in study areas in Bwamba county and near Entebbe, to act as indicators of localities where the infection was present, but none of them became infected. In 1947, however, it was found that *A. africanus* did not readily enter cages of the type used for the monkeys, and uncaged monkeys were secured on the platforms at Zika near Entebbe ; one of these became immune from yellow fever during September, thus showing the presence of an arboreal vector of the disease among monkeys in this region. In December of the same year, a rhesus monkey died of yellow fever 12 days after receiving a single inoculation of a suspension of *A. africanus*, taken in uninhabited forest in Bwamba, mostly in the canopy.

Arrangements for the exposure of uncaged monkeys in that area had not been completed. It is concluded that *A. africanus* is involved in the forest cycle of yellow fever.

UNSWORTH (K.). **Observations on the Occurrence of Larvae of *Oestrus ovis* in the nasal Cavities and frontal Sinuses of Goats in Nigeria.**—*Ann. trop. Med. Parasit.* **42** no. 2 pp. 249–250, 2 refs. Liverpool, 1948.

The occurrence of larvae of *Oestrus ovis* L. in the nasal cavities and sinuses of goats and sheep in Nigeria was recorded in 1937 but has apparently not been referred to in the literature since that time. Examination in May 1948 of the nasal chambers and frontal sinuses of 100 goats from Kafo and 120 from the Kano area showed that 19 and 78, respectively, were infested with one or more larvae. Most of the larvae were very young, but a few were mature. This suggests considerable fly activity during the period immediately preceding the examination, particularly in the Kano area where the climate at that time is hot and dry. Mature larvae placed on dry soil in a jar immediately penetrated below the surface and pupated, giving rise to adults after 25–26 days. The economic importance of *O. ovis* in Nigeria is difficult to assess as the goat population, though large, is scattered. However, it might become a serious pest should goat-farming and, more especially, sheep-farming be developed.

MAIER (P. P.) & DOW (R. P.). **Diarrheal Disease Control Studies. II. Conical Net for collecting Flies.**—*Publ. Hlth Rep.* **64** no. 19 pp. 604–607, 3 figs., 2 refs. Washington, D.C., 1949.

As neither baited traps nor conventional insect nets are entirely satisfactory for collecting Muscoid flies in very large numbers for medical studies [*cf. R.A.E.*, B **39** 86], a new type of conical net was developed. Details of its construction are given. It takes advantage of the tendency of the flies to approach light when their environment is suddenly darkened. A light 18-mesh wire-gauze cone 30 ins. in diameter at the base is lowered over the flies on an area attractive to them. It was found possible to do this without dispersing many flies. A cylindrical cage of wire gauze (preferably 20-mesh) is then fixed over a small hole in the apex of the cone and the rest of the cone is rapidly covered with a cape of heavy cloth. All the trapped flies congregate in the cage within a few seconds. The cloth cape should extend beyond the base of the cone as flies will escape downwards if light enters. A lid is slipped on to the bottom of the cage as it is lifted from the cone and is held in place by metal clamps. In a dry or very hot climate, the cages should be kept in a cool, or at least humid, container until the flies can be brought to the laboratory to be anaesthetised and sorted. In addition to being lowered over an attractive surface, the nets can be used to sweep flies out of weeds. They have also been used to collect flies following exposure to space sprays to observe the lasting effect of the insecticide and to study the species of flies attracted to particular baits. To evaluate Scudder's method of measuring fly densities [*R.A.E.*, B **38** 158], a larger pyramidal model that can be lowered over the fly-grill has been made.

APPLEWHITE (K. H.) & CROSS (H. F.). **Further Studies of Repellents in Alaska.**—*J. econ. Ent.* **44** no. 1 pp. 19–22, 1 ref. Menasha, Wis., 1951.

The following is virtually the authors' summary. Studies in Alaska on the effectiveness of repellents against mosquitos (*Aëdes* spp.) and *Culicoides* were continued in 1949 [*cf. R.A.E.*, B **39** 4]. Dimethyl carbate and propyl N,N-diethylsuccinamate were the most effective of 13 materials tested as skin

treatments against mosquitos. Results with 11 mixtures, each containing six parts dimethyl phthalate, two parts Indalone and two parts of another repellent, showed that the mixture containing dimethyl carbate was superior to the others. Except for this mixture, the one containing Repellent 6–12 [2-ethyl-1,3-hexanediol] (the standard 6 : 2 : 2 mixture) was about as effective as any other.

In cotton T-shirts, 2-[2-(2-ethylhexyloxy)ethoxy]ethanol was superior to all other repellents. Of four repellents tested for impregnating uniforms, Indalone was the most effective as a fresh treatment, but after various periods of wear the treatments showed little difference in effectiveness. The treated uniforms failed to reduce bites on the hands and heads of the wearers. Indalone was the most effective of 12 materials tested on head nets.

In tests against *Culicoides*, dimethyl phthalate was the most effective material tested for application to the skin. As clothing treatments, neither pyrethrum nor 2-[2-(2-ethylhexyloxy)ethoxy]ethanol was highly effective in reducing the numbers alighting.

Fales (J. H.), Nelson (R. H.), Fulton (R. A.) & Bodenstein (O. F.). **Insecticidal Effectiveness of Sprays and Aerosols containing Allethrin.**—*J. econ. Ent.* **44** no. 1 pp. 23–28, 8 refs. Menasha, Wis., 1951.

An account is given of experiments begun in Maryland in March 1949 to compare the effectiveness of allethrin [*cf. R.A.E.*, B **38** 208] against flies (*Musca domestica* L.), mosquitos (*Aëdes aegypti* (L.) and *Anopheles quadrimaculatus* Say) and *Periplaneta americana* (L.) with that of natural pyrethrins. All the tests were made in a Peet-Grady chamber and Freon 12 [dichlorodifluoromethane] and a 1 : 1 mixture of Freon 12 and Freon 11 [trichlorofluoromethane] were the propellents used for high- and low-pressure aerosols, respectively [*cf.* **38** 205, 206]. In tests with equal concentrations and rates of application for the two materials, allethrin both as a spray and as a high-pressure aerosol gave exactly the same kill of flies as natural pyrethrins [*cf.* **38** 208]. In the aerosol, allethrin appeared to be somewhat the slower in causing knockdown. In spray tests against females of *Anopheles* at equal low concentration and dosage, allethrin was much less toxic than the natural pyrethrins. However, when tested at 55·56 ml. per 1,000 cu. ft. of a solution containing 1 mg. allethrin per ml., it gave 99 per cent. kill of females of both *Anopheles* and *Aëdes* and complete kill of males. Eight tests in which aerosol formulations containing 1 per cent. allethrin or pyrethrins were released against cockroaches at 35 gm. per 1,000 cu. ft. showed the allethrin to be quite ineffective against the adult females and very little better against large nymphs. Natural pyrethrins were definitely superior but not very effective at the dosage used. Distillation of allethrin did not change its effectiveness against flies, nor did storage for four months of aerosol formulations containing it. DDT-resistant flies showed some resistance to allethrin.

In tests of high-pressure aerosols against flies, piperonyl butoxide, n-propyl isome and sesame-oil extractives all increased the knockdown and mortality given by mixtures containing allethrin, but there was considerable recovery of flies knocked down by the aerosol containing sesame-oil extractives [*cf.* **38** 133–134]. Substitution of allethrin for pyrethrins in an aerosol formula approved for use on aircraft did not alter its effectiveness against flies or mosquitos. When allethrin was substituted for natural pyrethrins in the Tentative Official Test Aerosol [**39** 6], equally good kill and somewhat better knockdown of house-flies were obtained. Allethrin and pyrethrum extract at equal concentrations in low-pressure aerosols containing also DDT and a synergist gave similar results against flies when the synergist was n-propyl

isome. Allethrin appeared to give slightly better kill with Van Dyk 264 [N-(2-ethylhexyl)bicyclo[2.2.1]-5-heptene-2,3-dicarboximide] than the pyrethrins, while with piperonyl butoxide, it gave lower knockdown than pyrethrins but about the same kill.

YATES (W. W.), GJULLIN (C. M.), LINDQUIST (A. W.) & BUTTS (J. S.). **Treatment of Mosquito Larvae and Adults with Radioactive Phosphorus.**—*J. econ. Ent.* **44** no. 1 pp. 34–37, 2 refs. Menasha, Wis., 1951.

The following is based on the authors' summary. Studies were begun in Oregon in August 1949 to determine how to introduce radioactive phosphoric acid (P^{32}) into both larvae and adult mosquitos in amounts that would be detectable with radioactive measuring devices. Females of *Aëdes sticticus* (Mg.) gave 544–897 counts per minute above background after they had been allowed to feed on the blood of rats that had received 0·375 millicurie of P^{32} in aqueous solution intraperitoneally 24 hours earlier. In three dissected specimens, an average of 72 per cent. of the radioactivity was found in the abdomen and 4 per cent. in the legs. Adults of *Culex tarsalis* Coq. reared from the second or third larval instar in water having an unknown concentration of P^{32} derived from droppings of the rats used in the previous experiment had radioactivity ranging from 164 to 417 c.p.m. Of this radioactivity, 15 per cent. was in the legs and 45 per cent. in the abdomen. Females of *A. sticticus* fed on water containing 10 per cent. sugar and an unknown concentration of P^{32} gave readings of 557–1,192 c.p.m. 1–13 days later. The legs had about 9 per cent. and the abdomens 41 per cent. of the total radioactivity.

Adults of *A. sticticus* and *A. vexans* (Mg.) reared from the second larval instar in water containing 0·05 microcurie P^{32} per ml. gave average readings of 41,147 c.p.m. for females and 39,072 for males. In later tests, concentrations of 0·01, 0·001 and 0·0001 microcurie per ml. gave 14,911, 1,612 and 522 c.p.m., respectively, for the females. It is suggested that a dosage equivalent to the lowest of these concentrations may be practical for the treatment of breeding places to yield adults for flight studies. With suitable measuring equipment, one-tenth this dosage might prove adequate. Since adults may be readily marked by feeding them on sugar solutions containing small amounts of P^{32}, this method may be found desirable in many studies.

WOOD (S. F.). **Importance of Feeding and Defecation Times of Insect Vectors in Transmission of Chagas' Disease.**—*J. econ. Ent.* **44** no. 1 pp. 52–54, 5 refs. Menasha, Wis., 1951.

Infection with *Trypanosoma cruzi*, the causal agent of Chagas' disease in man, depends on contamination of mucous membrane or a skin abrasion or bite wound by infective excreta of the insect vector or by its crushed body. The duration of feeding and frequency of defaecation of four species of Triatomines were studied in California as indications of their probable relative efficiency as vectors, the hosts being laboratory animals or man. The duration of the feeding period in six individuals of *Triatoma protracta* (Uhl.), seven of *T. rubida uhleri* (Neiva), one of *T. longipes* Barber and three of *Paratriatoma hirsuta* Barber ranged from 2 mins. 50 secs. (in *P. hirsuta*) to 29 mins. 10 secs. with two breaks (in *T. protracta*). The average was somewhat longer in *T. protracta* than in *T. r. uhleri*. There was some evidence that higher temperature shortened feeding time, but it was not conclusive. The intervals after feeding at which bugs of the four species deposited excreta during observation periods ranging from 103 to 294 mins. are shown in a table. The five adults of *T. r. uhleri* defaecated 9–11 times in 180 minutes after

feeding and usually first did so within a minute of the blood-meal, but ten of *T. protracta* observed for 103–294 minutes defaecated only 1–8 times, and four other adults of *T. protracta* failed to defaecate during observation periods of 89–223 minutes. The small number of observations on the other two species indicated habits comparable with those of *T. protracta*.

Although chance contaminative contact with the host through crushing at the time of feeding would appear to be more likely with *T. protracta* because of its longer feeding period, it is concluded that *T. r. uhleri* is probably the most important vector among the four species as the engorged bugs tend to defaecate immediately after feeding and frequently during the next hour. Undoubtedly, the aridity of the south-western United States, the small numbers of Triatomines that enter houses there and the low incidence of infection in the species that do so all contribute to keep man free of *Trypanosoma cruzi* even though experimental infection of man has been demonstrated with this trypanosome from a Texas source [*R.A.E.*, B **32** 57].

Quarterman (K. D.), Parkhurst (J. D.) & Dunn (W. J.). **DDT for Control of Stable Fly, or Dog Fly, in northwestern Florida.**—*J. econ. Ent.* **44** no. 1 pp. 61–65, 5 refs. Menasha, Wis., 1951.

In 1945 and 1946, DDT surface sprays replaced saturation sprays of creosote and water for the control of *Stomoxys calcitrans* (L.) breeding in beach deposits of marine vegetation along the shores of bays and sounds in north-western Florida [*cf. R.A.E.*, B **31** 95 ; **35** 23–24, etc.]. This necessitated the development of light equipment that would permit full use of the new treatment. The " swamp gliders " used by the Army Air Force as rescue boats in shallow water were adopted in 1945, and in 1946 continuous-spray apparatus that took water directly from the bay with a pump and eliminated the conventional sprayer tank and the tank-loading operation was installed in them, forming a light and efficient unit. This made it possible to reduce the number of units in operation. The use of DDT and the development of the light equipment for applying it reduced the cost of control to about one-third of that of control with creosote and gave better results. In 1945, a DDT by-product oil was used [*cf.* **35** 24] and an emulsion concentrate containing 70 per cent. of this diluted 1 : 99 in bay water was found to be adequate. Application was at about 400 mg. DDT (or its equivalent) per sq. ft. During most of 1946, a concentrate containing 35 per cent. by weight technical DDT was used at 1·5 per cent. by volume in the bay water. Army Air Force personnel at training bases in north-western Florida were successfully protected from annoyance by *S. calcitrans* for six years (1941–46) by the various control measures used.

Gersdorff (W. A.) & Mitlin (N.). **Relative Toxicity of Allethrin Analogs to House Flies.**—*J. econ. Ent.* **44** no. 1 pp. 70–73, 5 refs. Menasha, Wis., 1951.

Tests were made by the turntable method [*R.A.E.*, B **26** 246] of the toxicity to *Musca domestica* L. of five synthetic compounds related to allethrin (the ester of *dl*-2-allyl-4-hydroxy-3-methyl-2-cyclopenten-1-one with a mixture of *cis* and *trans dl*-chrysanthemum monocarboxylic acids). They differed only in the side chain of the keto-alcoholic component having 2-chloroallyl, 3-chloroallyl, 3-chloro-2-butenyl or 2-butynyl in position 2, or allyl in position 5 as well as in position 2. On the basis of concentration required for 50 per cent. mortality, they proved to be about 142, 156, 21, 73 and 41 per cent. as toxic, respectively, as the standard pyrethrum extract, which has been shown to be about 33 per cent. as toxic as allethrin [**39** 25].

GRANETT (P.) & FRENCH (C. F.). **Further Tests of Dibutyl Adipate as a Tick Repellent.**—*J. econ. Ent.* **44** no. 1 pp. 93–97, 2 refs. Menasha, Wis., 1951.

In continued field tests of tick repellents in New York [*cf. R.A.E.*, B **38** 185], impregnation of outer clothing with an emulsion containing 9 parts dibutyl adipate, 1 part emulsifier and 160 parts water at 2 gm. dibutyl adipate per sq. ft. gave 90–100 per cent. protection against *Dermacentor variabilis* (Say) for several weeks, and n-hexyl mandelate used in the same way was almost as good. The effectiveness of these chemicals persisted after two washings. Indalone was fairly good at first in one series of tests, but washing reduced its repellency by about half. In another, propyl adipate, N-n-butylacetanilide [*cf.* **38** 152], isopropyl adipate and Indalone gave only 82, 78, 71 and 68 per cent. protection after two weeks, whereas dibutyl adipate gave 99 per cent. It was found that any of three emulsifiers could be used with dibutyl adipate without affecting the repellency of the emulsion.

Low-pressure aerosols released from mixtures containing 5 or 15 per cent. dibutyl adipate or n-hexyl mandelate with equal parts of Freon 11 and 12 [trichlorofluoromethane and dichlorodifluoromethane] as the propellent were rapid and easy to use for the treatment of clothing and proved effective at 1–2 gm. active ingredient per sq. ft. Dibutyl adipate was preferred because of its lack of irritating properties and odour in a mist form. It is estimated that 3–4 complete treatments of trousers could be obtained from one low-pressure (1 lb.) aerosol bomb of the 15 per cent. concentration.

Both dibutyl adipate and n-hexyl mandelate provided fair protection for one day when applied to dogs in either the emulsion or aerosol form at 2 gm. per kg. body weight. Reapplication every few days would, however, be necessary for continued protection, and this might cause irritation of the skin. Evidence was obtained that dibutyl adipate used at 2 gm. per sq. ft. on clothing would not be harmful nor cause skin irritation in man ; n-hexyl mandelate is more irritant.

GRANETT (P.), HAYNES (H. L.) & HELM (R. W.). **Further Evaluation of Butoxypolypropylene Glycol as a Fly Repellent for Dairy Cattle.**—*J. econ. Ent.* **44** no. 1 pp. 97–102, 3 refs. Menasha, Wis., 1951.

Further field tests with butoxypolypropylene glycol 800 (B800) as a repellent against flies on dairy cattle [*cf. R.A.E.*, B **38** 86] alone and in combination with insecticides and in comparison with other sprays were made in 1949–50. It was used in oil solution against *Siphona irritans* (L.) in New Jersey and Delaware and *Stomoxys calcitrans* (L.) and house-flies [*Musca domestica* L.] in New York, and in water emulsion against *S. irritans* in New Jersey. The oil solutions were normally applied at 100 ml. per cow. A method of computing percentage repellency that takes into consideration possible fluctuations in the attractiveness of the cow to flies is described. It is based on a comparison of the attractiveness of the cow with that of the control cows before the treatment and fluctuations in the attractiveness of the control cows after it.

As a 10 per cent. oil solution against *S. irritans* in New Jersey in 1949, B800 was highly effective on the day of application but much less so on the following day and gave better protection on both days than 0·07 per cent. pyrethrins with 0·19 per cent. piperonyl butoxide in oil. There was no cumulative effectiveness on the fourth day after retreatment on the third day. In Delaware in 1949, 10 per cent. oil solutions of B800 alone and combined with 0·05 per cent. pyrethrins were compared with a 5 per cent. solution combined with 2 per cent. Thanite (isobornyl thiocyanoacetate), 3 per cent. Thanite in oil alone, a proprietary spray containing 0·07 per cent. pyrethrins and 0·19 per cent. technical piperonyl butoxide in oil, and 0·5 per cent. methoxy-DDT (methoxychlor) in

water. A second application of each spray on the third day was at 30 ml. per cow only. The B800 alone gave 90 per cent. protection and all the other sprays 97 per cent. or more on the first day and all gave 96 per cent. or over on the third day. The protection percentages on the second and fourth days were 9 and 70 for 3 per cent. Thanite, 87 and 94 for methoxy-DDT, and 68–77 and 88–92 for the other sprays. Against *Stomoxys calcitrans* and house-flies, 10 per cent. B800 and two proprietary pyrethrum sprays, of which the more effective one contained 0·03 per cent. pyrethrins and 0·25 per cent. technical piperonyl butoxide were applied on two consecutive days and counts continued for three days after the second spraying. B800 gave moderate protection and the pyrethrum sprays poor protection. B800 gave somewhat better protection on the second day under these conditions than it did against *Siphona irritans* in New Jersey.

The base oil used in repellent sprays has a definite effect on repellency and should be chosen to cause least interference with evaluation of a series of repellent ingredients or to give the maximum effectiveness in practical use. In tests made in New Jersey in 1950 with an oil that increased effectiveness more than the one previously used, a combination of 5 per cent. B800 with 3 per cent. Thanite was slightly more effective than a proprietary spray containing 0·07 per cent. pyrethrins and 0·19 per cent. technical piperonyl butoxide in petroleum distillate on the day of spraying and the following day and considerably better than sprays containing 8 or 10 per cent. B800 with 0·05 per cent. allethrin [the synthetic allyl homologue of cinerin I]. A water emulsion containing 2·5 per cent. B800 and 1·5 per cent. Thanite applied at 200 ml. per cow was as effective as 5 per cent. B800 and 3 per cent. Thanite in oil at 100 ml. per cow, but the addition of bentonite-sulphur to the emulsion as an adhesive did not increase repellency [*cf.* **38** 188].

LINDSAY (D. R.) & HAINES (T. W.). **A Method of testing the Resistance of House Flies to residual-type Insecticides.**—*J. econ. Ent.* **44** no. 1 pp. 104–106, 1 ref. Menasha, Wis., 1951.

During field work in south-western Georgia, a method was devised whereby the resistance of local strains of house-flies (*Musca domestica* L.) to several insecticides could be determined simultaneously within 48 hours of their being collected in the field. It thus became possible to change to the most effective insecticide before infestation had markedly increased, or, if the flies were found to be susceptible to an insecticide that was not giving satisfactory control, to seek other reasons for the failure.

Flies for testing are caught in a sweep net having a clear plastic cone with a central opening one inch in diameter inserted just below the rim, or in a cone net [*R.A.E.*, B **39** 133], modified by the substitution of a sheet-metal throat 3 ins. square in cross section and 4 ins. long for the one-inch opening at the top. This throat extends into a horizontal sheet-metal panel designed to receive a similar panel on which each collection cage is mounted. The cages are square in cross section to take full advantage of the opening in the throat. One cage may be filled from several settings of the cone net or several cages may be filled in rapid succession when flies are abundant on any one attractant. During field work, the flies collected are kept in an insulated box over ice, and after arrival at the laboratory, are stored for 18–24 hours to eliminate weak individuals and those affected by insecticides. During this time, they are allowed access to honey-water. Surviving flies are anaesthetised and sorted according to species and sex and then exposed for a uniform period to insecticide deposits in petri dishes, after which they are re-anaesthetised and transferred to jars with screen lids for observations on knockdown and kill. An easy technique for the thorough cleaning of the glassware between tests is described.

EDDY (G. W.). **Aminophenols as Antioxidants for Pyrethrum.**—*J. econ. Ent.* **44** no. 1 pp. 109–111, 3 refs. Menasha, Wis., 1951.

The author reviews work on the use of antioxidants (including anti-polymerisation agents) to retard the decomposition of pyrethrum [*cf. R.A.E.*, B **35** 39] and describes experiments carried out in Texas in May 1949 to determine whether the aminophenols would prolong the toxicity of pyrethrum deposits to *Stomoxys calcitrans* (L.). Pyrethrum at 0·05 per cent. pyrethrins in acetone was tested alone and with 0·5, 0·25, 0·05 per cent. o-, m- or p-aminophenol, and also with the same concentrations of piperonyl butoxide, this synergist being included for purposes of comparison. Copper-wire cages 3·5 ins. in diameter and 8 ins. high were dipped in the various solutions and stored at room temperature, and batches of 20 flies were placed in them 1–21 days thereafter and observed for knockdown and mortality after 24 hours at 80°F. All the materials caused rapid knockdown and complete mortality of flies exposed after one day. After three days, knockdown by the mixtures was slower, especially with the o- and m-aminophenols or the synergist, but all still gave complete mortality, though pyrethrum alone gave only 15 per cent. After eight days, mixtures containing m-aminophenol or piperonyl butoxide caused not more than 40 per cent. mortality, but mixtures containing all three concentrations of p-aminophenol and the two highest concentrations of o-aminophenol caused complete mortality then and also after 14 days. After 21 days, the mixtures containing 0·5, 0·25 and 0·05 per cent. p-aminophenol gave 100, 80 and 20 per cent. mortality, and those containing 0·5 and 0·25 per cent. o-aminophenol gave 95 and 50 per cent., as compared with 10 per cent. in controls. No appreciable mortality was caused by any of the aminophenols alone. A limited number of field tests against *S. calcitrans* and *Siphona irritans* (L.) showed that the p- and o-aminophenols extended the effectiveness of pyrethrum under practical conditions. However, because of possible irritant effect on the skin, the aminophenols cannot yet be considered for other than experimental purposes.

SWEETMAN (H. L.), WELLS jr. (L. F.), TOCZYDLOWSKI (A. H.) & MOORE III (S.). **Mange and Fly Control with Lindane in a Piggery.**—*J. econ. Ent.* **44** no. 1 p. 112, 1 ref. Menasha, Wis., 1951.

In view of recent reports of the toxicity of γ BHC (benzene hexachloride) to young mammals, particularly calves [*cf. R.A.E.*, B **39** 4], a summary is given of results obtained when young pigs were treated with lindane [containing at least 99 per cent. γ BHC] for the control of mange caused by *Sarcoptes suis* Gerl. and also of flies. A herd of pigs infested with mange was treated in February 1950 with a wettable-powder spray containing 0·046 per cent. lindane. The infestation was most severe in the youngest ones, which were about 4½ months old, and the 19 having the worst sores were retreated two weeks later with 0·075 per cent. lindane, although skin scrapings did not reveal any mites. The condition of the animals began to improve within 24–48 hours of the first application, and their weight increased within a week. No signs of injury by the insecticide were evident at any time, all wounds healed within 6–8 weeks of the first treatment, and there was no indication of reappearance of mange after six months.

Continuous vaporisation of lindane from an electrically heated device at 1 gm. per 24 hours per 26,000 cu. ft. was instituted about the middle of June for the control of flies, of which large numbers, consisting mostly of house-flies [*Musca domestica* L.] were developing. The fly population was quickly reduced and remained low. Sows with young pigs two or more weeks old were exposed during the first six weeks of the test, and even the youngest pigs were unaffected.

Some doors and windows were open throughout the test period, but less at night than during the day.

KOHLER (C. E.) & FOX (I.). **The relative Attractiveness of New Jersey Light Traps painted (a) green and (b) yellow to Puerto Rican** *Culicoides*.—*J. econ. Ent.* **44** no. 1 pp. 112–113, 5 refs. Menasha, Wis., 1951.

A light-trap of the New Jersey type painted chrome yellow proved superior to one painted forest green in sampling populations of *Culicoides* in Porto Rico. Data from 74 trap nights during five months of comparative running showed the yellow trap to make consistently higher catches than the green whether 25, 40 or 60–watt bulbs were used and whichever of the three common species was involved, the only exception occurring when populations were extremely low. There was some indication that the 40-watt bulb was more attractive than the weaker or stronger lights.

ROBERTSON jr. (R. S.) & GAINES (J. C.). **The Toxicity of certain organic Insecticides to different Strains of House Flies.**—*J. econ. Ent.* **44** no. 1 pp. 114–115, 1 graph, 7 refs. Menasha, Wis., 1951.

A comparative study was made of the toxicity of lindane [containing at least 99 per cent. γ benzene hexachloride], DDT and chlordan to adults of *Musca domestica* L. belonging to a laboratory strain that had not been exposed to any insecticide for eight years and to strains of which the parent stocks were collected in cattle sheds at a college in Texas where DDT deposits had been used continuously for five years (campus strain) and from untreated barns seven miles away (natural strain). The dosages in mg. per sq. ft. needed to kill 50 per cent. of the flies of the laboratory, campus and natural strains with 15 minutes' exposure were shown to be 1·99, 5·39 and 4·03, respectively, for DDT, 0·15, 0·05 and 0·19 for chlordan and 0·44, 0·04 and 0·48 for lindane. To obtain very high mortality, however, more DDT was needed with the laboratory strain than with the campus strain.

In tests lasting ten weeks, the toxicity of a DDT deposit of 5·43 mg. per sq. ft. in glass jars to adults of the natural strain was well maintained.

SULLIVAN (W. N.). **A Method of dispersing Lindane Vapor in Air.**—*J. econ. Ent.* **44** no. 1 pp. 125–126, 3 refs. Menasha, Wis., 1951.

The author has found that the concentration of vapour of lindane [at least 99 per cent. γ benzene hexachloride] obtained in an enclosed space by the passage of an air stream through an air filter treated with the compound is sufficient to kill certain insects [*cf. R.A.E.*, B **38** 209 ; **39** 139]. Both sides of a Fiberglas air-conditioning filter (16×25×1 ins.) are sprayed with lindane dissolved in acetone (1 : 7) until a total deposit of 15–100 gm. lindane is obtained. The acetone soon evaporates, leaving a heavy coating of crystals on the glass fibres, which greatly increase the surface area of the deposit ; the filter has a coating of oil, which apparently helps to retain the lindane crystals. It is fastened to the guard of a fan, which is set in operation and causes an air current to flow through it and disperse the volatile lindane to all parts of the room under treatment. Chemical analysis of the air from test rooms showed a concentration of 0·113–0·26 mmg. lindane per litre. About 27 mg. lindane was liberated in an 8,500 cu. ft. room in an hour.

Exposure of house-flies [*Musca domestica* L.] and mosquitos (*Aëdes* and *Anopheles*) for one hour resulted in 80–100 per cent. kill in 24 hours, and exposure for ten minutes in 74–100 per cent. kill. All horn-flies [*Siphona irritans* (L.)] were knocked down in 90 minutes. Grasshoppers were harder to

kill and Mexican bean beetles [*Epilachna varivestis* Muls.] and cockroaches showed little or no effect after exposure for an hour. The treated filters had not lost their effectiveness after two months.

It is emphasised that the effect of lindane vapour on man and livestock has not been determined, and its application is therefore not recommended in occupied buildings. It is probable that other partly volatile organic insecticides could be dispersed by this method.

JENKINS (D. W.). **Trombiculid Mites affecting Man. I. Bionomics with Reference to Epidemiology in the United States.**—*Amer. J. Hyg.* **48** no. 1 pp. 22–35, 7 figs., 11 refs. Lancaster, Pa., 1948. **II. Control of larval Behavior for Disease Transmission Studies.**—*T. c.* pp. 36–44, 3 graphs, 5 refs. **III.** *Trombicula* (*Eutrombicula*) *splendens* **Ewing in North America.**—*J. Parasit.* **35** no. 2 pp. 201–204, 4 figs. Lancaster, Pa., 1949.

The mites dealt with in these papers are referred to in the first two as *Eutrombicula alfreddugèsi* (Oudm.), *E. masoni* (Ewing) and *E. batatas* (L.), but in the third, the author adopts without comment the view that *Eutrombicula* is a subgenus of *Trombicula* and shows that *T. masoni* is a synonym of *T. splendens* Ewing. He reared larvae collected in Florida at the type locality of *T. masoni* (the adults of which were not known) and obtained adults identical with *T. splendens* and second-generation larvae identical with the types of *T. masoni*. Characters are given distinguishing the adults and larvae of *T. splendens* and *T. alfreddugèsi*. The former is the chief species attacking man in the south-eastern United States, especially Florida. It is known from all the coastal States from Texas to Massachusetts and also from Minnesota, Wisconsin, Michigan, Arkansas, Tennessee, Kansas and Nebraska and from Ontario in Canada. The larvae are most abundant in coastal swamps, bogs and moist places.

The following is largely based on the author's summaries of the first two papers. *T. alfreddugèsi* occurs over most of the eastern United States from New York and Minnesota southwards, and in California and Arizona in the west. It has also been recorded in Mexico, Central America and several West Indian islands, and in South America as far south as Argentina. It is abundant in second-growth cut-over areas, especially where there are many birds, mammals and reptiles, and in river valleys. *T. batatas* has a more restricted distribution ; its known range includes Florida, Georgia, Alabama, Mexico, Panama, Porto Rico and northern South America.

The average periods for which Trombiculid larvae are active in different parts of the United States are shown. They vary from two months in summer in the north to the whole year in southern Florida. A list is given of 83 mammals, birds, reptiles and amphibians known to be attacked by the larvae, showing the species that have been recorded from each host. *T. batatas* is found only on birds and mammals, but the other two on all four groups. Unfed larvae live on débris on the surface of the ground, or occasionally on low branches. They are most abundant in shrubby transition areas between forest and grassland or at swamp borders. They can live in nature without a host for over a month. The time needed for engorgement varied greatly and was shortest (4–5 days) in July and August. Engorged larvae required an average of about two days to migrate and transform to protonymphs, after which they remained quiescent for about six days, the time between engorgement and emergence of the nymph varying between four and 20 days during July–September. Nymphs were usually found on the surface of moist ground under logs and sticks and in the bases of grass clumps and to a depth of three inches in drier soil. The adults are found, principally in winter and early spring, on the surface

of moist ground or 2 or 3 ins. below the surface of drier soil, often in the bases and rootstocks of grass and in sphagnum moss, and under logs and between the roots of trees, usually where insects are numerous. It is probable that the eggs of soil-inhabiting insects form most of their food and possible that adults of *T. splendens* are of some value in destroying eggs of *Aëdes* and *Psorophora*, as they are often common in depressions in which eggs of these mosquitos overwinter. Most evidence indicates that the winter is passed in the adult stage. The reproductive potential is high. The number of eggs laid per day by *T. splendens* in captivity reached 15 per female. A definite fortnightly ovulation cycle was observed independent of temperature, light or humidity. Individual females produced offspring throughout the year and one series of females was still ovipositing after 20 months. Characters for the identification of larvae, and field methods of collecting and mounting are given.

The examination of larval behaviour described in some detail in the second paper was undertaken to facilitate studies on the transmission of tsutsugamushi disease (scrub typhus). Reared larvae of *T. splendens* and *T. alfreddugèsi* were used. Activity rates were measured in a glass arena having controlled temperature, relative humidity and light. Activity was initiated by a change in the intensity or direction of light or by movement of the air, of the substratum or of some object. The direction of movement was determined almost entirely by light, and its rate primarily by temperature. Larvae were either positively or negatively phototactic according to whether they had been conditioned in light or in darkness. Larvae attracted to the brightest area in a horizontal arena by a vertical beam from above circled round the edge of the bright area. Movement took place between 7° and 47°C. [44·6° and 116·6°F.] and was most rapid (3 ft. per minute) at 45°C. [113°F.]. The rate of movement on the human body was about 2 ft. per minute. An air current reduced activity, and movement was somewhat slower on a rough surface than on a smooth one. No difference in the rate of movement was observed between the two species or between reared larvae and those found in the field. A diurnal activity rhythm was observed, with a marked decrease in activity in the afternoon. It was possible to control the movements of the larvae almost completely by manipulating their environment, and this should be of value in experimental transmission studies to prevent the escape of very small larvae infected with tsutsugamushi disease.

McCarthy (D. D.) & Wilson (D. B.). **Dengue in the East African Command. Incidence in Relation to *Aëdes* Prevalence and some clinical Features.**—*Trans. R. Soc. trop. Med. Hyg.* **42** no. 1 pp. 83–88. London, 1948.

Dengue has been recognised for many years on the east coast of Africa, but only occasional cases have been diagnosed in British East Africa and no epidemic is known to have been recorded there. An account is given of the occurrence of dengue in the East African Command during the years 1941–45 when it was largely confined to a few localities in which *Aëdes* [*aegypti* (L.)] was especially plentiful. The disease was particularly prevalent at Dire Dawa and Harrar in Ethiopia, Mogadishu in Somalia and Diego Suarez in Madagascar, and there was a sharp epidemic on the Comoro Islands [*R.A.E.*, B **32** 141] and small numbers of cases elsewhere. The clinical features of the Madagascar and Comoro cases are described. The disease was almost completely eradicated from Mogadishu and Diego Suarez by the control of *Aëdes*, but whereas it disappeared from the former when the *Aëdes* index [percentage of houses in which the mosquito was breeding] fell below 10, it persisted in the latter until this index had fallen below 2.

Anderson (T. F.). **Tick Control by Gammexane.**—*E. Afr. med. J.* **24** no. 7 pp. 259–261. Nairobi, 1947.

It was formerly thought that *Ornithodoros moubata* Murr., did not occur in British Somaliland and that *O. savignyi* (Aud.) was the most important and possibly the only vector of relapsing fever there. It has recently been established, however, that *O. moubata* Murr., is very common and occurs in houses and coffee shops, whereas *O. savignyi* has not been seen in these places but occurs in the open. An experiment on the control of *O. moubata* by spraying with benzene hexachloride (666) [*cf. R.A.E.*, B **37** 15] was carried out in coffee shops. The ticks were greatly reduced in numbers after the first application of spray and almost completely eliminated after the second (a fortnight later), whereas a reduction observed in the untreated control shops was comparatively slight.

[Kas'yanov (A. F.).] **Касьянов (А. Ф.) Winter Parasitisation by Ticks of the Family Ixodidae on Farm Animals in the Province of Khabarovsk.** [*In Russian.*]—*Veterinariya* **24** pt. 10 pp. 14–15. Moscow, 1947.

Horses, cattle, sheep and reindeer were examined for ticks in 1938–47 at 50 localities in 29 different districts in the Province of Khabarovsk, Soviet Far East. The examinations were made during the winter, when the animals are kept in indoor quarters, and 195 of the 307 investigated were infested, the percentages and (in brackets) the average numbers of ticks per infested animal being 62 (5) for horses, 65 (6) for cattle, 50 (3) for sheep and 80 (2) for reindeer. Of the 1,061 ticks removed, none of which had engorged, 95·6 per cent. were adults of *Dermacentor silvarum* Olen., of which males represented rather more than half, and the rest were adult males of *Haemaphysalis concinna* Koch. *H. concinna* was restricted to the south-eastern and central parts of the Province, where deciduous broad-leaved forests and open habitats are present, but *D. silvarum* extended northwards to the edge of the tundra. The ticks were found chiefly on animals that had been kept on the pastures right up to the end of the grazing period. The preferred sites of attachment were the ears, but ticks occasionally occurred on the neck and dewlap, and in male horses frequently on the genitals. In order to prevent ticks from being carried by their hosts to previously uninfested sites, the animals should be freed from infestation in winter by hand-collection, or where warm quarters are available, by rubbing with solutions of sodium arsenite containing 0·22–0·24 per cent. arsenic trioxide. To protect the animals from winter infestation, they should be transferred at the end of August or beginning of September to fresh grazing grounds free of ticks, such as harvested fields and mown meadows free of shrubs.

[Priselkov (A. M.), Khatin (M. G.) & Ganelina-Lur'e (M.Z.).] **Приселков (А. М.), Хатин (М. Г.) и Ганелина-Лурье (М.З.). Early Treatment of the Warble-fly Disease of Cattle.** [*In Russian.*].—*Veterinariya* **25** pt. 1 pp. 14–17. Moscow, 1948.

An account is given of investigations in the Soviet Union to find substances that would penetrate the skin of cattle and kill larvae of *Hypoderma* in the subcutaneous tissues before the warbles had passed the incipient stage. Observations on slaughtered animals in the central part of the Union showed that the larvae reach the subcutaneous tissues in the second half of January or the beginning of February, that minute, hardly noticeable orifices then appear in the skin and that the warbles develop on these sites in the second half of February.

In all, 2,766 cattle were treated, some on both sides, but most on one side only, the other serving as a control. In most cases the hair was not clipped. The preparations were warmed and brushed into the back from the fore edge of the

shoulder-blade to the base of the tail. The animals remained under observation for 3–4 months and were examined at least once a week.

Of the various materials tested, the best were decoctions of the rhizomes of white hellebore [*Veratrum album*], prepared by adding the chopped rhizomes to water, boiling in a water-bath for an hour, allowing the liquid to cool and draw for 1–2 hours and then pressing out the remains of the rhizomes. A single application of a 10–20 per cent. decoction (the 10 per cent. with 3 per cent. soap) killed all the larvae and arrested the formation of warbles on the treated side, with no injury to the animals. Infestation on the untreated side was heavy. Similar results with two applications, 30 days apart, were given by pyrethrum extract in water or 5–7 per cent. solutions of DDT in oil, but three applications of emulsified solutions of DDT were required, though they contained higher concentrations of DDT. An oil solution of dixanthogen (bis-ethylxanthogen) was also effective with three applications, as was treatment with sodium thiosulphate (hyposulphite) and hydrochloric acid or sodium bisulphate, as used for control of ectoparasites [*cf. R.A.E.*, B **32** 179 ; **34** 11] ; the dilute hydrochloric acid was applied twice after the thiosulphate solution had dried, and the bisulphate (as a solution or a powder) before it had done so.

MALDONADO (J. F.), HERNÁNDEZ MORALES (F.), FOX (I.) & THILLET (C. J.). **The Incidence of Filariasis *bancrofti* in Government Institutions for Children in Puerto Rico.**—*P. R. J. publ. Hlth* **24** no. 2 pp. 121–134, 4 refs. Burlington, Vt., 1948. (Also in Spanish pp. 135–149.)

In connection with a survey of the incidence of filariasis, caused by *Filaria* (*Wuchereria*) *bancrofti*, in three children's homes in Porto Rico, mosquitos collected in the various homes were dissected. *Culex fatigans* Wied. (*quinquefasciatus* auct.), which constituted about 95 per cent. of the total, was the only species found infected. The others taken were *Aëdes sollicitans* (Wlk.) and *A. aegypti* (L.) [*cf. R.A.E.*, B **36** 115]. At two of the homes where conditions were fairly good, and the incidence of filariasis low (3·8 and 1·3 per cent.), there were not many mosquitos and only 2 and 1 per cent., respectively, of those examined were infected, but at the third home, where conditions were poor and 10·4 per cent. of the inmates had microfilariae in the blood, mosquitos were abundant and 14·7 per cent. of those examined were positive. The average number of larvae per infected mosquito at this home was 9·7, and advanced stages of development were common.

PAPERS NOTICED BY TITLE ONLY.

PIQUETT (P. G.) & BOWEN (C. V.). **Effect of abrasive Diluents on the Toxicity of Lindane** [almost pure γ benzene hexachloride] **to the American Cockroach** [*Periplaneta americana* (L.)].—*J. econ. Ent.* **44** no. 1 pp. 118–119, 4 refs. Menasha, Wis., 1951. [See *R.A.E.*, A **39** 274.]

SCHECHTER (M. S.), GREEN (N.) & LAFORGE (F. B.). **Constituents of Pyrethrum Flowers. XXIII. Cinerolone and the Synthesis of related Cyclopentenolones.** —*J. Amer. chem. Soc.* **71** pp. 3165–3173, 51 refs. Easton, Pa., 1949.

DEICHMANN (W. B.), WITHERUP (S.), KITZMILLER (K. V.) & HEYROTH (F. F.). **The Toxicity of DDT** [to mammals]. **Part I. Experimental Observations . . . Part II. A Survey of the Literature.**—[2+]vi+233+16 pp., 15 pls., 33 tables (1 fldg.) [on 52 pp.], 257 refs., multigraph. Cincinnati, Ohio, Kettering Lab., Coll. Med., Univ. Cincinnati, 1950. [See *R.A.E.*, A **39** 262.]

WEST (T. F.), HARDY (J. E.) & FORD (J. H.). **Chemical Control of Insects.**—$7\frac{1}{2} \times 5\frac{1}{2}$ ins., xi+211 pp., 44 figs., refs. London, Chapman & Hall Ltd., 1951. Price 15*s*. [See *R.A.E.*, A **39** 261.]

DENT (J. E.), MORLAN (H. B.) & HILL (E. L.). **Effects of DDT Dusting on domestic Rats under Colony and Field Conditions.**—*Publ. Hlth Rep.* **64** no. 21 pp. 666–671, 1 graph, 5 refs. Washington, D. C., 1949.

Data obtained from studies made in a laboratory colony of *Rattus rattus* and limited field collections of rats in Georgia [*R.A.E.*, B **39** 108] show that the distribution of 10 per cent. DDT in pyrophyllite in the habitats of domestic rats was followed by pathological changes in the rats consistent with DDT poisoning and in the accumulation of appreciable quantities of DDT and DDA (dichlorodiphenyl acetic acid) in the livers and fat of exposed rats. These results indicated that the DDT dusting not only decreased rat fleas significantly [**39** 109] but also affected the rat populations directly. In the building housing the colony, which measured 20×100 ft., 10·5 lb. dust was distributed on the floor in patches and bands about 2 mm. deep in such a way that the rats had to pass through them to reach food and water. The rats avoided the dust at first but became accustomed to it in a few hours, and 15, 25, 30 and 36·3 per cent. had died, apparently from DDT poisoning, within 2, 4, 6 and 11 weeks, respectively. The field observations indicated that such mortality rates are greater than can be expected in nature where rats can exercise greater freedom in avoiding treated areas.

KARTMAN (L.). **Preliminary Observations on the Relation of Nutrition to Pediculosis of Rats and Chickens.**—*J. Parasit.* **35** no. 4 pp. 367–374, 2 figs., 14 refs. Lancaster, Pa., 1949.

Experiments to determine the effect of deficient diets on louse infestation were carried out between November 1947 and July 1948 on rats artificially infested with *Polyplax spinulosa* (Burm.) and on fowls in states of mild or severe malnutrition artificially infested with *Eomenacanthus stramineus* (Nitzsch).

Rats that received diets deficient in vitamin A, thiamin (vitamin B_1), riboflavin (vitamin B_2) or pantothenic acid maintained a mild infestation, though the number of lice never equalled or exceeded the original number put on the host. There was no evidence that the lice could carry on a normal life-cycle [*cf. R.A.E.*, B **28** 59; **32** 19]. The infestation of the rats deficient in riboflavin was maintained only if the fur was normal, not if the hosts showed alopecia. Rats that received diets deficient in pyridoxine (vitamin B_6), folic acid or choline rid themselves of infestation, as did control rats receiving a complete diet. Host activity may have been a factor in producing these results.

Fowls in a state of mild malnutrition showed no apparent difference in degree of infestation with *E. stramineus* as compared with others in robust health, but fowls in a state of severe malnutrition had significantly less lice and less louse eggs than well nourished ones. A tendency towards a reversal of the situation was noticeable within 34 days of the diets of the groups being reversed. The normal birds on a deficient diet lost lice more rapidly than deficient birds put on to a normal diet gained them. Birds that had been debeaked, in accordance with regular practice in Hawaii, had more lice than those with normal beaks. This was particularly noticeable in the case of birds on a full diet.

PERRY (W. J.). **Studies on *Mansonia xanthogaster* and its Relation to Filariasis in the South Pacific.**—*J. Parasit.* **35** no. 4 pp. 379–382, 4 figs., 2 refs. Lancaster, Pa., 1949.

Filaria (*Wuchereria*) *malayi* was first found in the New Hebrides in 1944, but extensive studies have failed to reveal any mosquito responsible for its

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transmission. Particular attention was devoted to *Mansonia xanthogaster* (Edw.), the only species of *Mansonia* found there, because other members of the genus transmit the microfilariae elsewhere, but no infective-stage larvae were found in it. It is concluded that *F. malayi* is not transmitted in the New Hebrides, but occurs in the blood of imported Tonkinese labourers.

During the work, the author made biological observations on *M. xanthogaster*, and discovered the aquatic stages for the first time. He describes the larva and the distinguishing characters of the pupa. They were found attached to a species of *Pandanus* growing in depths of 1–3 ft. in heavily shaded, overgrown fresh-water swamps. Breeding was continuous throughout the year except where shallow swamps, dependent on rainfall, evaporated during the dry season. Females taken in the field deposited eggs in rafts. Larvae hatched after 72 hours, and the period from egg to adult varied from 21 to 26 days.

Scott (J. A.). **Longevity of tropical Rat Mites kept without Food.**—*J. Parasit.* **35** no. 4 p. 434. Lancaster, Pa., 1949.

Some 200–300 individuals of *Liponyssus bacoti* (Hirst) from a colony reared on a rat were placed in a vial five days after the rat had been removed from the rearing box. About 100 and 50 were still alive 14 and 29 days after the opportunity to feed, five on the 52nd and 56th days, two on the 59th and 61st days, one on the 63rd day and none on the 66th day.

Farrell (C. E.) & Wharton (G. W.). **A Culture Medium for Chiggers (Trombiculidae).**—*J. Parasit.* **35** no. 4 p. 435. Lancaster, Pa., 1949.

In North Carolina, *Trombicula alfreddugèsi* (Oudm.) and *T. splendens* Ewing are reared in jars, the bottom of which is covered to a depth of 2·5 cm. with a hardened mixture of 90 parts plaster of paris and 10 parts activated charcoal by weight bound and subsequently kept moist with distilled water. Over this, a loose substratum is provided. Cellulose wadding [*cf. R.A.E.*, B **37** 61] was unsatisfactory. Soil, humus and peat moss were used successfully but had disadvantages including lack of uniformity, variable content of organic material, tendency to become covered with fungus, high density and high cohesiveness. A layer 0·5 cm. thick of regular or medium-sized vermiculite, a mica-like mineral used as a diluent or substitute for soil in greenhouses, proved excellent, being light, soft and not cohesive, so that it can be rolled from side to side to expose mites for observation and to break up fungal mycelia.

Tonking (H. D.) & Gébert (S.). **The Use of DDT residual Sprays in the Control of Malaria over an Area of 16 Square Miles in Mauritius.**—*Publ. med. Hlth Dep. Mauritius* no. 40, [1+]23 pp., 1 fldg. map, 10 refs. Port Louis, 1947.

Gébert (S.). **Notes on certain Aspects of the Action of DDT residual Sprays, and on the partial Treatment of Dwellings as a Means of anti-Anopheline Protection.**—*Trans. R. Soc. trop. Med. Hyg.* **42** no. 3 pp. 295–297, 1 ref. London, 1948.

The first of these papers consists of a comprehensive account of an experiment carried out over an area of 16 sq. miles in western Mauritius on the effect of toxic deposits of DDT in the absence of other measures on malaria endemicity among a highly infected population numbering about 2,600. The topography, climate and population of the area and the Anopheline breeding places in it, which are very well suited to *Anopheles funestus* Giles, are described, and the

cost of the work is discussed. The total internal area of the dwellings and animal shelters involved was nearly 1,600,000 sq. ft. This area was sprayed with a 4·6 per cent. solution of DDT in kerosene in September–November 1946 at 177·5 mg. per sq. ft., in January–February 1947 at 111·5 mg. and in May–June at 150 mg. In the winter season before spraying began, 11,879 individuals of *A. funestus* and 177 of *A. gambiae* Giles were taken in the huts by hand-catching and knockdown with a pyrethrum spray. This is the time of year when Anopheline and malaria incidence are lowest. Females of *A. funestus* appeared to stay about a week in a house, during which period they fed about four times. *A. gambiae* showed a marked preference for animal shelters, whereas *A. funestus* was hardly ever taken in them. Of 1,457 females of *A. funestus* dissected, 1·23 per cent. contained oöcysts and 0·27 per cent. sporozoites, and 50 females of *A. gambiae* showed no infection. In addition, 5·14 and 8 per cent., respectively, of these species and 8·33 per cent. of 72 females of *Culex fatigans* Wied. were infected with microfilariae [of *Filaria bancrofti*]. After spraying, only five adults of *A. funestus* and two of *A. gambiae* were found in the treated huts or outhouses. Anophelines had not become less plentiful in an untreated area.

A survey of the population in August 1946 showed a parasite index of 37·6 per cent. and a gametocyte rate of 3·4 per cent. ; a survey of the pupils of Bambous school in 1942 had shown parasite and gametocyte rates of 65·5 and 30 per cent., respectively. In March 1947 (the middle of the hot season), the parasite and gametocyte rates of the population had fallen to 10·5 and 2·5 per cent. and those of the school children to 25 and 2·7 per cent. In June, the corresponding figures were 12·9, 2·2, 32·4 and 3·8, whereas the parasite and gametocyte rates in a control village were 46·5 and 7·54. The original aim of maintaining the malaria rate at the winter level throughout the year had thus been vastly improved upon. Individual infections also were much lighter. In view of these results and the fact that any attempt to eradicate Anophelines from the Island must take account of the prevailing wind, spraying with DDT on a large scale was begun in the south-eastern corner of the Island. It is considered possible to free the Island of malaria in a few years by the co-ordinated use of DDT deposits against adult Anophelines, DDT in oil against the larvae, and drugs.

The fact that 12,056 Anophelines were taken in the buildings before the application of DDT but none dead and virtually none alive for 3–4 months after it, whereas *C. fatigans* continued to enter and to be found alive, is thought to show that the DDT was repelling the Anophelines so that they did not enter the houses. This theory is the subject of the second paper. The author believes that the disintegration of DDT is accompanied by the emission of micro-waves, either electronic or sound, with which the antennae of *A. funestus* are in resonance, and therefore, provided there is enough DDT on the part of a dwelling for its reflection to cover the whole of the region approached, the house should be protected.

In an experiment in five huts just outside the treated area, parts of four huts (one end wall and the roof above it, half of one long side in one room and the other half of the opposite side at the other end in the other room, the end walls and a partition wall, or the whole of one side wall and the roof above it) were sprayed with a 4·6 per cent. solution of DDT in kerosene. Before spraying, they yielded, respectively, 469, 1,452, 401 and 151 adults of *A. funestus*, 4, 3, 3 and 1 of *A. gambiae* and 19, 25, 14 and 6 of *C. fatigans*, whereas no mosquitos of any of these species were taken in them 10, 36 and 50 days after spraying. The number of mosquitos taken in the untreated control hut before and 10, 36 and 50 days after the other huts were sprayed were 121, 133, 15 and 12 of *A. funestus*, 4, 2, 1 and 1 of *A. gambiae* and 6, 2, 0 and 0 of *C. fatigans*.

Reid (J. A.). **A Laboratory Method for testing residual Insecticides against Anopheline Mosquitos.**—*Bull. ent. Res.* **41** pt. 4 pp. 761–777, 7 figs., 18 refs. London, 1951.

This paper is in two sections. In the first, an account is given of experiments carried out in the course of developing an apparatus and technique for testing insecticide deposits against mosquitos under conditions in which they could leave the treated area as they can in a treated house. The species used was *Anopheles vagus* Dön. It was established that the mosquitos are quiescent by day, if not disturbed, whether kept in the light or in darkness. If they are in complete darkness at night, they fly vertically upwards, and will readily escape through a small hole in the top of a cubic cage in their continued attempts to fly upwards. On the other hand, they will fly sideways or even slightly downwards towards a source of dim light and in this way pass through openings which they would miss in complete darkness. Light will not cause them to fly vertically downwards. A few experiments made with *A. maculatus* Theo. showed that it is less responsive to light under these conditions than is *A. vagus*.

The apparatus devised as a result of these findings consists of a communicating reservoir cage, main cage and light-trap, each fitted with a sleeve. The reservoir cage, in which adults are allowed to emerge from pupae, is a 9-in. cube with mosquito gauze sides and wooden top and bottom, and has a hole about ½ in. in diameter in the top near one side. The hole is normally closed by a cork, but is open during experiments to give access to the main cage through a tube. The main cage is 2 ft. high on a base 18 ins. square and consists of a wooden framework with the top, bottom and side furthest from the tube of wood and the other three sides of gauze. Plywood panels, treated or untreated, can be fitted to the inner side of the sides and top to make a dark closed box. The light-trap is a small box 7 ins. square that slides into position on the outside of the main cage. The top and the front are of gauze and the remaining sides of light plywood. A hole 2 ins. in diameter in the middle of the back coincides with one in the upper part of the wooden side of the main cage, and the panel for this side of the cage has a similar hole. The base of a truncated gauze cone about 6 ins. long is fitted to the hole in the back of the light-trap, and the narrow opening (about ½ in. in diameter) is fastened to the gauze front of the trap with cotton threads.

To carry out an experiment, the reservoir cage containing about 50 mosquitos of both sexes is darkened with a cloth at the end of the afternoon and connected to the bottom of the main cage. It is tilted so that the mouth of the tube is near the highest point. The dim light from a window or a low-power electric light penetrates the main cage through the light-trap. The mosquitos are attracted to it and, after resting on the panels of the main cage for varying and unknown lengths of time, pass through the funnel into the trap. The performance of an insecticide under test is assessed by counting the living and dead mosquitos in the reservoir, main cage and light-trap, and comparing the figures with those from an identical control cage with untreated panels.

In the second section, the results are given of tests of three insecticides made in the apparatus described. Plywood panels were treated with DDT or chlordan at 200 mg. per sq. ft. or BHC(benzene hexachloride) at 40 mg. γ isomer per sq. ft., all as suspensions of wettable powder. When the deposits were fresh, BHC, chlordan and DDT gave respectively 100, 98 and 85 per cent. kill of *A. vagus* overnight, but after ageing for nine weeks, the order had changed and they gave 31, 11 and 42 per cent. kill, respectively. Chlordan and DDT were equal after three weeks and DDT and BHC after six. A considerable mortality occurred amongst mosquitos that had survived the overnight tests with DDT and BHC and were kept for a further 48 hours. More females were killed than males, especially by DDT and chlordan. It is concluded from kills of adults kept out

of contact with the treated panels and of larvae kept in a bowl in the main cage that BHC and chlordan had a strong fumigant effect. BHC on a panel just outside one of the gauze sides of the cage had a marked repellent effect, comparable with that of citronella oil, but whereas citronella oil repelled without killing, BHC also caused high subsequent mortality. DDT, tested in the same way, appeared to have a definite action as a fumigant and as a repellent [*cf.* *R.A.E.*, B **39** 147], but subsequent tests of fumigant effect by a different method, in which the pure p,p′isomer as well as the 33 per cent. wettable powder previously tested were used, gave negative results, though a 25 per cent. wettable powder caused complete mortality. It is concluded that if DDT has any fumigant effect, this is not due to the p,p′isomer, and that some records in the literature of the repellency of DDT deposits to mosquitos in houses can be explained by the irritant effect of contact and not by true repellency operating at a distance.

DDT and BHC were each tested once against *A. maculatus* in the main series of experiments and killed it much more readily than *A. vagus*, probably because of its weaker response to light.

BEVAN (W. J.) & EDWARDS (E. E.). **Studies on the Ox Warble Flies, *Hypoderma lineatum* and *Hypoderma bovis*.—*Bull. ent. Res.* 41** pt. 4 pp. 639–662, 10 figs., 26 refs. London, 1951.

Early knowledge on *Hypoderma lineatum* (Vill.) and *H. bovis* (Deg.) is reviewed and their economic importance is outlined as an introduction to an account of a study of certain aspects of their biology and control made in South Wales over a period of several years, culminating in intensive investigations in 1945–46. These investigations showed that the adults of *H. lineatum* begin to emerge from their puparia early in May and those of *H. bovis* a month later. The ovipositing females of both species worry cattle in calm, sunny weather from the end of May to early September, with maximum activity in late June and in July, but they tend to avoid the neighbourhood of water and shade.

Larvae were present in the backs of cattle from January to July. Marked differences in their seasonal appearance were found to be correlated with the relative prevalence of one or other species in different districts, *H. lineatum* being most plentiful in March and *H. bovis* in June. The species appeared to occur in about equal numbers in South Wales as a whole, and no locality was entirely free from either. Of 171 cattle observed throughout the 1945 season, about 9 per cent. remained free of infestation and about 65, 21 and 4 per cent. had 1–15, 16–30 and over 30 larvae each, respectively. In a similar examination of 125 cattle in 1946, 18·4 per cent. remained free of warbles. Degrees of infestation otherwise resembled those in the previous year. Herds on exposed upland pastures were generally less infested than those on more shady, lowland farms, and cattle less than three years old were more often and more heavily infested than older ones. The average length of time spent by 504 larvae in the vertebral region of the host was 42·5 days [*cf.* *R.A.E.*, B **19** 115]. Larvae first began to leave the cattle to pupate during the last week in February, and the percentages that left them in February, March, April, May, June and July were about 1, 32, 26·2, 17·5, 18·4 and 4·9 in 1945 and 2·5, 28, 32, 26·4, 9 and 1·5 in 1946. The onset of pupation is much earlier than had been assumed for Britain on the basis of observations in Worcestershire, where only 1·4 per cent. were reputed to have left by 28th March. On the basis of the dates in South Wales, it is suggested that insecticides should be applied about 9th March, 8th April, 10th May and 13th June, with a fifth application in July where *H. bovis* is the dominant species.

In comparative tests with a dust containing 5 per cent. DDT, emulsified solutions containing 1–5 per cent. DDT and a dust and a water suspension

containing, respectively, 2 and 1 per cent. γ benzene hexachloride, all were ineffective for destroying the larvae in their warbles even though some of the liquids were injected into the breathing holes, but DDT in emulsified solution applied as a spray to the legs and flanks of cattle during the period of oviposition showed great promise and warrants further investigation [but *cf.* **34** 173]. The concentration used was 1 per cent., and three applications at the rate of 1 pint per animal were made at about fortnightly intervals during the oviposition period of *H. bovis*. The average numbers of larvae per animal in the backs of the treated and control cattle in the following season were 2·1 and 7·2.

GARRETT-JONES (C.). **The Congo Floor Maggot, *Auchmeromyia luteola* (F.), in a Laboratory Culture.**—*Bull. ent. Res.* **41** pt. 4 pp. 679–708, 1 pl., 9 figs., 39 refs. London, 1951.

The following is virtually the author's summary. An account is given of the life-history of *Auchmeromyia luteola* (F.) in a laboratory culture maintained in London for two and a half years. Attention was centred on the blood-sucking larva, which is an intermittent ectoparasite specific to man. It was reared chiefly on the natural host, but a strain has been maintained on shorn guinea-pigs through several generations. It was also found possible to rear the larva on free blood.

The known distribution of *A. luteola* is reviewed on the basis of published records, museum collections and information from scientists in Africa. The species is highly successful in both the wettest and the driest parts of the Ethiopian region, but does not seem to extend south of Durban. It can flourish only where man occupies permanent settlements and makes his bed on the floor within reach of the maggot. Strains originating in Nyasaland, the western part of the Belgian Congo, and the Anglo-Egyptian Sudan were successfully cross-mated and produced fertile eggs. The second generation from these crosses, however, was not always fully fertile.

The method of cultivation of the material is described. Batches of eggs hatched 36–60 hours after oviposition when kept at 26–28°C. [78·8–82·4°F.] and 50–60 per cent. relative humidity. Development was delayed in drier atmosphere, and took 3–7 days at 23°C. [73·4°F.] and 10 per cent. humidity. The habits of the larvae are discussed, and it is shown that larvae took 20 minutes to gorge (although newly hatched ones often stopped feeding after ten minutes). Given the opportunity, a meal was taken daily except for a day missed before each moult. No larva could be induced to bite twice in one day unless the first feed had been interrupted. The rate of growth was strongly influenced by the feeding schedule, larvae receiving four meals a week having a much higher rate than those receiving only two. It was also correlated with temperature, but the correlation with relative humidity was less marked. After fasts of several days, meals of the order of 2·5 times their own weight were taken by larvae of all three instars. Larvae fed four times a week and kept at 23°C., besides growing faster than others fed at less frequent intervals, reached higher maximum and pupal weights and started to pupate on the 26th day. Larvae fed at less frequent intervals took larger meals, but lighter pupae and flies were produced. The time of moulting appeared to be directly related to weight and only through this to the environment. The first moult occurred after the larva had gorged to a weight of 1·5–2·1 mg. (usually after two or three meals), the second moult after it had reached 12–19 mg. (after 4–7 meals).

There are wide limits of weight between which the onset of pupation can occur, the upper limit being higher for female than male larvae. If the feeding schedule (in relation to climate) is favourable, the larvae reach a maximum

weight, which induces the onset of pupation regardless of other factors. If the meals are scarce, growth is retarded more than metabolism, and time becomes the limiting factor ; then, the scarcer the meals, the smaller, not the later, the pupae. The larvae die if the meal schedule is so adverse that they cannot reach the minimum weight for pupation (about 97·5 mg.) in the time set by their metabolic rate in the given climate. No larva has been known to complete an instar on a single meal. The minimum for complete development in any climate is probably six meals, two in each instar. Larvae reared at 28·5°C. [83·3°F.] in 60 per cent. relative humidity on five meals a week moulted after three and seven meals and pupated after 16 or 17. Failure to moult, followed by death, occurred in all strains in the laboratory. It is believed that this is sometimes due to overcrowding and sometimes to the larva being disturbed when ready to moult. Inability to moult was commonest in the dry atmospheres and among larvae fed only twice a week. Saturated air was fatal to the larva but not to the pupa. The species tolerates a wider range of atmospheric humidity than most insects, and was even reared successfully in an atmosphere of 10 per cent. relative humidity. Female larvae in the third instar take more blood than males and lose more by excretion ; they also grow larger and produce heavier pupae and adults. The temperature lethal in one hour to larvae having completed the second moult was 42·5–43·5°C. [108·5–110·3°F.] and did not appear to vary according to atmospheric humidity.

The larvae can survive fasts perhaps longer than those of any other Diptera. At 28·5°C. and 90 per cent. relative humidity, first-instar larvae, unfed, after one meal and after two meals, survived for 9–20, 8–21 and 4–21 days, respectively ; third-instar larvae after moult (at 12–19 mg.) and at about 90 mg. survived for 17–18 and 28–47 days. At the same temperature but 10 per cent. relative humidity, much more weight was lost and the survival time was much less. At 23°C., newly hatched unfed larvae survived for 5–37 days at 60 per cent. relative humidity and 9–22 days at 10 per cent., while third-instar larvae survived for 25–48 days at 90 per cent. and 9–19 days at 30 per cent. Newly hatched larvae lived for 3–8 days at 35°C. [95°F.] in 60 per cent. relative humidity.

The length of the pupal stage was about 9 days at 34°C. [93·2°F.], 11 days at 28·5°C. and 15–16 days at 23°C. and was unrelated to atmospheric humidity. Percentage losses in weight at different humidities were studied ; they were about 16 and 25 at relative humidities of 90 and 10 per cent., respectively.

The habits of the adult flies are discussed ; human faeces appear to be the staple diet. The male seeks the female persistently, and mating is protracted and occurs repeatedly. One male can fertilise several females. Oviposition and development continue all the year round without diapause. In the laboratory at 22–23°C. [71·6–73·4°F.], a female normally laid about 54 eggs at the first oviposition, and one female laid as many as six batches of fertile eggs. In warm weather, the first batch was laid about 16 days after emergence (or after 20–23 days at 23°C.), smaller batches being laid subsequently at intervals of 5–8 days. The female lived in the laboratory for up to 93 days and the male for up to 85 days. The life-cycle under natural conditions is roughly estimated as ten weeks, so that five generations a year might be expected.

EVANS (G. O.). **The Distribution of *Ixodes ricinus* (L.) on the Body of Cattle and Sheep.**—*Bull. ent. Res.* **41** pt. 4 pp. 709–723, 8 graphs, 7 refs. London, 1951.

The following is based on the author's summary of this account of investigations made in Wales in 1946–48 on the distribution of populations of *Ixodes ricinus* (L.) (mainly females) on the bodies of dairy cattle [*cf. R.A.E.*, B **39** 44] and sheep [*cf.* **39** 43]. Female ticks are almost entirely confined to the head and axillary and inguinal regions of cattle. Larvae and nymphs attach on the

head and below the hock joints on the fore- and hind-legs. The percentage of females on the forequarters of cattle increases during the season, whether in spring or autumn. During the early stages of a season's activity, the hindquarters carry more than the forequarters. Later in the season, the position is reversed. If ticks are picked up on the fore region of the cattle, as is believed to be the case in sheep, this may be due to a deliberate movement of ticks towards the hindquarters during the early stages of tick activity or the attachment of ticks near the site of arrival later in the season. There is no evidence for the former supposition, but Lees in a paper already noticed [**39** 94] has shown that recently moulted ticks need a more prolonged stimulation for attachment than older and more hungry ones, and therefore move further from the site of arrival.

The head, axillary and inguinal regions are the chief sites of attachment of the females on sheep. In ewes, the head region carries the highest percentage, but the axillary region is the most heavily infested on lambs. This difference may be due, to some extent, to the fleece of the ewes, which may form a barrier to the movement of unfed ticks towards the axillary and inguinal regions. Lambs were more heavily infested between 21st April and 6th June than ewes on the same grazing. The degree of infestation of lambs and ewes is probably determined by the interaction of the amount of ground covered by the animal (dependent on the distance it travels and the breadth of its body) and the nature of the fleece. The amount of ground covered governs the number of ticks picked up. The proportion of ticks on lambs is low when they are young and becomes high as they grow bigger and more active. Milne's findings in Northumberland that ewes are much more heavily infested than lambs [**39** 43–44] is attributed to the fact that the lambs he examined were born in the middle of April and reached their period of maximum proportionate infestation in June when all tick populations are low.

There is no reliable method of estimating the total infestation on cattle, but a good representation of the seasonal incidence of female ticks on the host can be obtained from the hindquarters count. The standard (forebody) count on sheep [**39** 43] may be used for estimating total infestations. The ratio on ewes in spring was 1·198 and remained relatively constant with a range of 1·141 to 1·300. The ratio on lambs from 21st April to 6th June was 1·409 and was less reliable than the ratio for ewes. For estimating infestation on lambs, the method may be improved by using two constants, one for infestations during April and May and the other for the lighter infestations in June. The ratios calculated for these two periods were respectively 1·426 (range 1·340 to 1·691) and 1·238 (range 1·183 to 1·357).

Bruce (W. N.) & Decker (G. C.). **Tabanid Control on Dairy and Beef Cattle with synergized Pyrethrins.**—*J. econ. Ent.* **44** no. 2 pp. 154–159, 5 figs., 1 ref. Menasha, Wis., 1951.

Preliminary experiments in Illinois in 1947 and 1948 having shown that emulsion sprays containing 0·125 per cent. pyrethrins and 2·5 per cent. piperonyl butoxide would protect cattle from Tabanids for 3–5 days [*cf.* also *R.A.E.*, B **37** 161 ; **38** 89], a further test was made on dairy cattle in 1949 using a Pyrenone concentrate (T-143) containing 1 per cent. pyrethrins and 10 per cent. piperonyl butoxide to determine the most economical procedure. The value of frequent light applications was shown. Protection was best (98·2 per cent.) and the least material was used (12–24 ml. per cow per week) when light applications of the undiluted concentrate were made twice daily with hand sprayers. Commercially available oil repellents containing 0·025 per cent. pyrethrins and 0·25 per cent. piperonyl butoxide did not afford effective protection from Tabanids when used at 1–2 oz. spray per animal per day.

In 1950, 12 dairy herds were treated at least twice weekly after 29th June with Pyrenone emulsion sprays at concentrations giving not less than 0·1 per cent. pyrethrins and 1 per cent. piperonyl butoxide. The average dosage needed for excellent protection from Tabanids (mainly *Tabanus sulcifrons* Macq.) was 10–15 oz. emulsion (1–1·5 oz. concentrate) per cow per week. Before receiving Pyrenone, seven of the herds had been treated with DDT, three with methoxy-DDT (methoxychlor) and two with repellents. Of 13 control herds, six were treated with DDT, five with methoxy-DDT and two with oil repellent sprays. The data are summarised for four periods of 30 days each, two before treatment and two during it. Analysis of these gross data showed a highly significant beneficial change in butterfat production as a result of the time of treatment. The strong inverse correlation of the changes in pounds of butterfat and changes in number of Tabanids on the cattle between the June and July test periods for all 25 herds was −0·747, with −0·4869 required for significance at the 1 per cent. level. The increase in butterfat production resulting from the Pyrenone treatment of the 12 herds was calculated to be 13–14·8 per cent.

An "automatic micro-spray applicator" made possible the first practical control of Tabanids on range cattle in 1950. The unit consisted of a home-made chute with a treadle in the floor that operated small overhead hydraulic pumps connected to a can filled with spray concentrate. The apparatus sprayed 0·6–1 ml. concentrate on each animal as it walked through the chute on its way to drink or lick salt. The average amount of concentrate used daily was 2·4 ml. per animal. The mean numbers of *T. sulcifrons* per steer from 20th June to 27th July in the field in which the apparatus was set up was 0·09 as compared with 3·56–11·83 on steers in adjacent control pastures. The protected cattle appeared to gain 20–30 lb. more during the 38 days than those in the control pastures. There was good correlation between the mean numbers of Tabanids and weight gains in all pastures. The treated animals were also kept free from the few other species of Tabanids present and from horn-flies [*Siphona irritans* (L.)].

Lindquist (A. W.), Roth (A. R.), Yates (W. W.), Hoffman (R. A.) & Butts (J. S.). **Use of Radioactive Tracers in Studies of Penetration and Metabolism of DDT in House Flies.**—*J. econ. Ent.* **44** no. 2 pp. 167–172, 7 refs. Menasha, Wis., 1951.

A sample of DDT containing 0·25 millicurie of C^{14} (radioactive carbon) as tracer, randomly distributed through the benzene rings, was used to study the penetration of DDT through the cuticle of individuals of *Musca domestica* L. and its metabolism in the fly. In view of the low specific radioactivity of the preparation, flies of a DDT-resistant strain were used in most of the work, and the first tests were made by applying 15 mmg. radioactive DDT to the dorsal surface of the thorax of each fly. After 24 hours, both the dead and surviving flies were washed in acetone to remove exterior DDT, and then macerated, and the DDT or metabolites were extracted with acetone. The quantities recovered in the wash and extract were determined by radioactivity measurements and conversion to equivalent weights. The weights of radioactive material (DDT or metabolites) per fly recovered from the flies that survived and those that were killed by DDT were 11·7 and 13·2 mmg., respectively, of which 2·1 and 2·3 mmg. (18 and 17 per cent.) were in the extracts. In tests in which resistant flies were exposed to a deposit of 5 mg. radioactive DDT per sq. ft. for 3–6 hours and examined in the same way, the weights of DDT or metabolites per fly in the extracts of the surviving and dead flies were 0·21 and 0·26 mmg., representing 87 and 76 per cent. of the totals recovered. According to these data, about ten

times as much absorbed DDT is needed to cause about 50 per cent. mortality when absorption is through the thorax as when it is through the feet.

In many bioassay tests in which flies of a strain susceptible to DDT were exposed to deposits from the external washes or extracts of topically treated resistant flies, the deposits from the washes killed rapidly but those from the extracts showed little or no toxicity to flies confined for 24 hours. As more than 1 mmg. was needed to cause mortality, further tests were made with fourth-instar larvae of flood-water *Aëdes*, which are more sensitive. The toxicity of the radioactive chemicals in the extracts was compared with that of a known quantity of DDT, and it was estimated in two series of tests that 63 and 50 per cent. of the material in the surviving flies and 71 and 60 per cent. of that in the flies that died was non-toxic and therefore metabolised DDT. In separate experiments, neither of the known metabolites, 2,2-bis(parachlorophenyl)acetic acid (DDA) and 2,2-bis(parachlorophenyl)-1,1-dichloroethylene (DDE) [*cf. R.A.E.*, B **38** 209] killed mosquito larvae at 0·01 part per million. It is believed that the material that was toxic was unmetabolised DDT. Bioassay tests with flies that had been exposed to DDT deposits indicated a somewhat similar degree of metabolism to that in the topically treated flies. Bioassay tests with topically treated susceptible flies indicated that about 31 per cent. of the DDT that penetrated the cuticle was metabolised to a non-toxic product in surviving flies and 70 per cent. in flies that were killed. This finding is important as it suggests that susceptible flies as well as resistant ones can metabolise DDT [*cf. loc. cit.*].

Fales (J. H.), Nelson (R. H.), Fulton (R. A.) & Bodenstein (O. F.). **Insecticidal Effectiveness of Aerosols and Sprays containing Esters of synthetic Cyclopentenolones with natural Chrysanthemum Monocarboxylic Acid.**—*J. econ. Ent.* **44** no. 2 pp. 250–253, 3 refs. Menasha, Wis., 1951.

The results are given of laboratory tests in which two partly synthetic analogues of cinerin I, prepared by esterifying *dl*-2-allyl-4-hydroxy-3-methyl-2-cyclopenten-1-one and *dl*-4-hydroxy-3-methyl-2-(2-methylallyl)-2-cyclopenten-1-one with natural *d-trans*-chrysanthemum monocarboxylic acid, were compared with natural pyrethrins in sprays and high pressure liquefied gas aerosols, and the natural-acid allyl ester was also compared with the completely synthetic allyl ester (allethrin). In aerosols and sprays, the methyl-allyl ester and allethrin were about as effective as the pyrethrins against house-flies (*Musca domestica* L.) and the natural-acid allyl ester was considerably more effective. The aerosol solution containing this ester was stored for eight months without loss of effectiveness. The natural-acid allyl ester in a spray was also more effective than the pyrethrins against *Anopheles quadrimaculatus* Say.

The effect of substituting the partly synthetic esters for natural pyrethrins in practical aerosol formulae containing 3 per cent. DDT was also studied. Both gave aerosols that caused higher knockdown of house-flies than those containing pyrethrins and equal kill, but were ineffective against large nymphs of *Periplaneta americana* (L.). The two esters were further tested against nymphs and adults of *P. americana* when substituted for pyrethrum in one of the DDT aerosol formulae used by the United States Public Health Service in aircraft. A formulation containing 1 per cent. of the allyl ester in addition to the pyrethrins and DDT was also included. Only this one was equal to the regular formula. Tested against house-flies, it was shown to be superior to the regular formula in both knockdown and kill. A formula containing 4 per cent. allyl ester was then tried and appeared to be one of the most effective aerosols yet tested. It gave complete mortality of large nymphs and adult

females of *P. americana* when applied at a rate at which the formula without the ester killed only 57 per cent. of the nymphs and 28 per cent. of the adults.

EDDY (G. W.). **Toxicity of some organic Insecticides to Screw-worm Larvae.**—*J. econ. Ent.* **44** no. 2 p. 254, 1 ref. Menasha, Wis., 1951.

An account is given of laboratory tests of several chlorinated-hydrocarbon insecticides and also parathion and diphenylamine against larvae of *Callitroga hominivorax* (Coq.) (*americana* (Cush. & Patt.)). Diphenylamine was included because it is the chief protective ingredient in Smear 62 [*R.A.E.*, B **30** 195]. Tests against newly hatched larvae were made with various concentrations of the insecticides dissolved in a 9 : 1 mixture of acetone and a polyoxyalkylene derivative of sorbitan monolaurate (Tween 20) and added to a nutritive medium [**39** 64]. Full-grown larvae were immersed in acetone solutions of the materials for about 10 seconds and then transferred to moistened sand for pupation, kill being computed from the percentage of flies reared. The most toxic materials against the mature larvae were parathion, dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8,-diendomethanonaphthalene] and lindane [containing at least 99 per cent. γ benzene hexachloride]. These all gave complete kill at 0·1 per cent. and 98, 90 and 76 per cent. kill, respectively, at 0·05 per cent. Aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene], heptachlor [1(or 3a),4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7,endomethanoindene] and Compound 153 (1,2,3,-4,10,10-hexachloro-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene) all caused complete mortality at 0·25 per cent. but not at 0·1 per cent. Chlordan and toxaphene caused complete mortality at 1 per cent. but not at 0·5 per cent. Diphenylamine, DDT, methoxy-DDT (methoxychlor) and DDD (TDE [dichlorodiphenyldichloroethane]) failed to kill all larvae at 10 per cent. Parathion was also the most toxic against the newly hatched larvae, causing complete mortality in 48 hours at 0·0001 per cent. but not at 0·00005 per cent. Lindane was the next most toxic, causing complete mortality at 0·005 but not at 0·001 per cent. Dieldrin, aldrin, heptachlor and DDT all gave complete kill at 0·01 per cent. but not at 0·005 per cent. Compound 153 and diphenylamine gave complete kill at 0·05 and the others at 0·1 per cent. but not at 0·01 per cent. Parathion, lindane, dieldrin, aldrin and heptachlor affected growth of the larvae at concentrations considerably lower than those necessary to cause complete mortality in 48 hours.

GOULD (G. E.) & MOSES (H. E.). **Lesser Mealworm Infestation in a Brooder House.**—*J. econ. Ent.* **44** no. 2 p. 265. Menasha, Wis., 1951.

Heavy infestation of deep litter in two brooder houses in adjoining counties of Indiana by beetles and their larvae was reported in September 1950 and January 1951. In the first case, the species was identified as *Alphitobius diaperinus* (Panz.). As 5,000 chicks out of 6,000 in the second house had died, an investigation was made to determine whether the beetles could be the cause. On 10th January, the surviving chicks were three weeks old and were confined under two brooders in a corner of the brooder house. The litter under the chicks was tightly packed and slightly damp, and no insects were found in it. About ten feet away, the litter was loose and heavily infested, with an average of 88 larvae and 18 adult beetles per U.S. quart in the sample examined. The temperature of this part of the house was about 50°F. Newly hatched and unfed chicks forcibly fed with five beetles, five larvae or ten larvae each and then placed on normal food with untreated chicks were all thriving a week later, and week-old chicks kept without food for 12 hours and then fed on 40 crushed beetles or 50 crushed larvae each all remained healthy.

DeFoliart (G. R.). **A Comparison of several Repellents against Blackflies.**—*J. econ. Ent.* **44** no. 2 pp. 265–266. Menasha, Wis., 1951.

During investigations into the bionomics and control of Simuliids in the Adirondack Mountains, the effectiveness of several repellents against them was tested. *Prosimulium hirtipes* (Fries), *Simulium venustum* Say and *S. perissum* D. & S. were abundant and biting freely throughout the tests. The biting rate varied from less than one to 15 per minute. The repellents were applied at the rate of 1 cc. to the forearms and 1·5 cc. to the legs between knee and ankle. Exposure times varied from 354 to 518 minutes, but a test of a given repellent was ended when five bites had been received. As the first bite was often received long before the second, and subsequent ones were grouped more closely together, the protection time was considered to be terminated when the third bite occurred. No third bite was received during the period of exposure in two of three tests with propyl N,N-diethylsuccinamate, one of three with Repellent 6-12 [2-ethyl-1,3-hexanediol] and one of two with dimethyl carbate (dimethyl ester of cis-bicyclo-[2.2.1]-5-heptene-2,3-dicarboxylic acid). The protection or average protection times in minutes in the other tests were 413 for propyl N,N-diethylsuccinamate, 391 for 2,2′-thiodiethyl diacetate, 389 for Repellent 6-12, 371 for cyclohexyl acetoacetate, 313 for the standard 6 : 2 : 2 mixture of dimethyl phthalate, Indalone and Repellent 6-12, 298 for 1,5-pentanediol dipropionate, 280 for dimethyl phthalate, 280 for Indalone and 265 for dimethyl carbate. *P. hirtipes* was apparently repelled for a shorter time than the other species.

Eads (R. B.) & Hightower (B. G.). **Ectoparasites taken from Texas Goats.**—*J. econ. Ent.* **44** no. 2 p. 287. Menasha, Wis., 1951.

During the examination of about 100 angora goats in Texas for ectoparasites, seven adults of *Haemaphysalis leporis-palustris* (Pack.) were taken on four goats. Larvae and nymphs of this tick have previously been recorded from goats but apparently not adults. An adult was also taken on a cow in July and a nymph on *Citellus mexicanus*. Two nymphs of a species of *Ixodes* found on a goat in Uvalde County in May were stated by G. M. Kohls to be apparently *I. tovari* Cooley. This tick, which was described from "hares" in Mexico, has not been recorded from the United States or from goats. Other ticks taken were ten individuals of *Otobius megnini* (Dugès) on eight goats and 16 of *Dermacentor variabilis* (Say) on 15. All the goats examined were infested with *Linognathus africanus* Kellogg & Paine. Infestation by *Damalinia* (*Bovicola*) *caprae* (Gurlt) was noted less commonly, and one individual of this louse was found on a dog.

[Ostashevskiĭ (A. G.).] **Осташевский (А. Г.). Test of parasiticidal and toxic Properties of DDT-5 against ectoparasitic Diseases of Animals.** [*In Russian.*]—*Veterinariya* **25** pt. 3 pp. 32–34. Moscow, 1948.

In the experiments described, mange mites (*Psoroptes* spp.) and sucking and biting lice of various species were placed on a thin layer of DDT-5 (5 per cent. DDT in talc) in petri dishes and kept at 0–12°C. [32–52·6°F.], 20–24°C. [68–75·2°F.] or 33–35°C. [91·4–95°F.]. When they ceased to move, they were transferred to a humid chamber and kept at 30–34°C. [66–93·2°F.] until death. All the active stages of the mites died in 6–7 days, 2–3 days and 6–15 hours, and all the lice in 2–3 days, 24 hours and 3–6 hours when the temperatures of exposure were 0–12, 20–24 and 33–35°C., respectively. There was no mortality in the controls. Eggs of *Haematopinus suis* (L.) exposed to the dust for five days at 25–30°C. [77–86°F.] hatched, but nymphs that remained in contact with the dust died in 2–4 hours.

Tests were then carried out to ascertain the effects of the dust on domestic and laboratory animals. Many of them were infested by ectoparasites, but the dust was applied uniformly over the entire body without especial regard to control requirements. Up to three applications at intervals of three days were made. Horses and cows showed no ill effects after three treatments. One application had no effect on pigs, but one of five died after a second dusting and another after a third, both with symptoms of severe poisoning. Within a day of the first application, the horses and cows were freed from biting and sucking lice, and the pigs from *H. suis*. Of the laboratory animals, normal guineapigs and rabbits showed symptoms of poisoning after three applications of the dust, but recovered in 1–2 days, whereas two guineapigs that had skin injuries were severely affected after a single application, and one of them died. As white mice died after a single application, baits prepared from equal parts of the dust and bread or minced meat were tested against rats and mice on the premises and proved very effective.

Hens heavily infested by *Menopon gallinae* (L.) (*pallidum* (Nitzsch)) were freed from it in 5–10 hours after a single application of the dust in September 1946, with no ill effects, but five of 25 hens dusted in October, during moulting, died within 3–5 days.

Rates of application of the dust recommended on the basis of these experiments are 14–17 oz. for a cow or horse, 5–7 oz. for a pig and 0·3–0·5 oz. for a hen. As it is a strong intestinal poison, care should be taken not to apply it in the region of the mouth.

[Egorov (I. A.) & Leont'ev (F. M.).] **Егоров (И. А.) и Леонтьев (Ф. М.). Acaricidal Properties of DDT, Benzene Hexachloride, "K" Soap against Ticks—Transmitters of Haemosporidioses of Horses.** [*In Russian.*]—*Veterinariya* **25** pt. 3 pp. 35–37. Moscow, 1948.

Preparations tested against ticks, mainly *Dermacentor silvarum* Olen., in the laboratory comprised K soap [which contains dixanthogen (*R.A.E.*, B **31** 227)] at a concentration of 5 per cent. in water, SK dust, the composition of which was unknown [*cf.* **31** 226; **32** 5], dusts containing 5 per cent. BHC (benzene hexachloride), 5–10 per cent. DDT or 5–10 per cent. diphenylamine, and suspensions of 0·5–5 per cent. DDT or BHC, alone or with the addition of 0·5 per cent. soap and 0·5–1 per cent. commercial kerosene. The only ones that gave complete mortality in 48 hours were the K soap and the BHC dust. The DDT and BHC dusts were harmless to horses and rabbits, as were the suspensions without soap and kerosene, but when these were added, they proved highly toxic. Only the DDT and BHC dusts and the K soap in water were tested against ticks on these animals, and only one application of each was made. The DDT dusts and the K soap were unsatisfactory, but the BHC dust gave complete mortality of ticks placed on treated rabbits and horses within 60 and 24 hours, respectively. It also protected horses treated at the rate of about 7 oz. per animal and put to graze in an infested pasture, whereas horses treated with the DDT dust and the K soap became infested within 24 hours.

[Nanobashvili (V. I.).] **Нанобашвили (В. И.). The Effect of the Decoction of the Root and Rhizome of Hellebore on the Quality of the Wool of Sheep.** [*In Russian.*]—*Veterinariya* **25** pt. 8 pp. 39–40, 1 ref. Moscow, 1948.

Since decoctions of the roots of white hellebore (*Veratrum album*) have proved effective against mange mite on domestic animals in the Soviet Union, experiments were carried out in Georgia to ascertain whether they have any harmful effect on the wool of treated sheep. Decoctions prepared by boiling the root or rhizomes for 30–90 minutes in 2, 6 or 10 times their weight of water,

filtering and making up to replace the water evaporated, were rubbed for 5–10 minutes into the skin and wool on the shoulders of sheep of three different breeds, and samples of the treated wool were examined and compared with untreated ones. No deterioration was detected.

[Marikovskiĭ (P. I.).] **Мариковский (П. И.). The Veterinary Importance of the poisonous Spider** *L. tredecimguttatus.* [*In Russian.*]—*Veterinariya* **25** pt. 8 pp. 41–43. Moscow, 1948.

Stock owners in Kazakhstan usually slaughter animals that show symptoms of poisoning by *Latrodectus tredecimguttatus* (Rossi) because it is assumed that they will not recover, but the validity of this assumption has not been proved. Tests were therefore carried out at Alma-Ata in 1947 in which mature female spiders in the early oviposition stage were induced to bite sheep or goats in the region of the groin ; in some cases, the spider was pressed against the animal, while in the act of biting. In tests in which the spiders bit repeatedly without pressure, they frequently discharged little or no poison, as was shown by the weak development or absence of the symptomatic bright red mark on the skin. In tests in which the spider bit once only, but was pressed while doing so, the poison was discharged rapidly and apparently in considerable quantity. The symptoms of poisoning, which are described in detail, were not severe unless the spider was pressed. Sheep that had been bitten by one spider only, once with pressure or repeatedly without it, recovered, but two that had each been bitten by four spiders had to be slaughtered and two that had been bitten by three spiders with pressure died in about 18 hours. The goats survived the bites of four spiders.

Eichler (W.). **Salzwasserverträglichkeit und Sommerphase des** *Anopheles atroparvus.* [Salt-water Tolerance and Summer Phase in *A. maculipennis* var. *atroparvus.*]—*Proc. 8th int. Congr. Ent., Stockholm* 1948 pp. 856–859, 4 refs. Stockholm, 1950.

The water of the Yanovskoe Lake, near the southern shore of the Sea of Azov and north of the Kuban River, has a very high salt content (2·17 per cent. at the end of August 1943). It is rich in magnesium sulphate, sodium and chlorine compounds, and organic impurities. *Anopheles maculipennis* var. *atroparvus* van Thiel, which breeds for preference in brackish water, is abundant in the immediate vicinity of the lake, forming an isolated population surrounded by pure populations of *A. m. messeae* Flni., with which apparently it does not intermingle. The salt concentration of the lake is reduced in winter, and the *atroparvus* larvae can develop in it in spring, but they cannot do so in summer when the concentration becomes too high for them. No Anopheline larvae were found in the lake on 11th July or 17th August 1943, and there were no other possible breeding places within several miles, but hundreds of adults (mostly females) were counted in an isolated house on 11th July, and almost equally large numbers (with a high proportion of males) were found in many houses in a village very near the lake, where they had persisted for over five weeks. Females taken near the lake at the end of August laid eggs in the laboratory. All were typical *atroparvus* eggs, except for a peculiarity of marking that was hardly sufficient to indicate a geographical race. The females chose river water from the Kuban in preference to undiluted lake water for oviposition, the only batch of eggs laid on lake water being abnormal. In experiments in which eggs laid on river water were put in batches of 40 in pans containing river water alone or various dilutions of lake water in river water, the greatest proportion of eggs (39 out of 40) hatched and larvae developed best in water with a salt content of 0·32 per cent. (15 per cent. lake water). The salt concentration that larvae could withstand increased as they grew

older. This was thought to be an adaptation to the rising salt content of the lake in early summer. Development was possible in water with a salt content of 0·87 per cent. but not 1·52 per cent.

The author concludes that the females do not oviposit in summer, when no water suitable for the development of the larvae is available, and take only sufficient blood-meals to support metabolism during this time. Only one generation is produced in the spring, but it is possible that a second develops in the autumn if the salt concentration in the lake falls soon enough.

TERZIAN (L. A.) & STAHLER (N.). **The Effects of larval Population Density on some Laboratory Characteristics of** *Anopheles quadrimaculatus* **Say.**— *J. Parasit.* **35** no. 5 pp. 487–495, 3 figs., 2 refs. Lancaster, Pa., 1949.

Preliminary work directed towards standardising the behaviour of laboratory-bred mosquitos indicated that larval development affects the adult. This report is concerned with investigations of the effects of two extremes of larval population densities (2·3 and 0·2 sq. ins. water surface per larva, respectively) on *Anopheles quadrimaculatus* Say. The materials and methods used are described. About the same amount of food was available per larva in the two types of colony, and there was no significant larval mortality in either.

Pupation usually began on the eighth day and was completed on the tenth in the underpopulated colonies, but began on the tenth and continued until the 20th or 21st in the overpopulated colonies. The sex ratio of the pupae changed from day to day in an overpopulated colony as successive groups pupated. The average length of the larval period in these colonies was 14·4 days for males and 16·5 for females. As the biting behaviour of females in batches of mosquitos reared from pupae taken from a crowded colony on different days appeared to vary, experiments were made to determine whether differences in the sex ratio were responsible. A reliable positive correlation was found between the biting rate and the proportion of males. Experiments in which the proportion of the sexes was altered just before a blood-meal was offered gave evidence that mating rather than the mere presence of males was the significant stimulant. Females that had had no contact with males never took a blood-meal. In subsequent experiments in which the sex ratio was controlled, the biting rate of females from underpopulated colonies was in certain circumstances significantly greater than that of females from over-populated colonies, and the variation in the biting rate within a single over-populated colony was considerably greater than that within the underpopulated colonies. With poor biting conditions, the biting rate of females from an overpopulated colony showed a consistent relationship with the numbers pupating each day in the colony, being lowest for individuals pupating when the fewest were doing so and highest in those pupating when the pupation rate was greatest. The reason for this is not clear. When conditions were more favourable, biting was more erratic.

On the basis of measurement of the paddle from the base of the buttress to the apical seta, pupae from underpopulated colonies were significantly larger than those from overpopulated ones and there was less variation in size among them. Pupae from underpopulated colonies were also about three times as heavy. As the larval period lengthened in crowded colonies, mortality in the pupal stage and during emergence increased. When maintained on water only, adults from underpopulated colonies lived about twice as long as those from crowded ones, but when sugar or raisins were given, little difference could be seen. Differences in survival time of adults from crowded colonies were not apparent if they were fed on raisins and water or water alone, but if they were given sugar for two days and then water, survival time decreased as the larval period lengthened.

Lewis (D. J.). **The Extermination of *Anopheles gambiae* in the Wadi Halfa Area.**—*Trans. R. Soc. trop. Med. Hyg.* **42** no. 4 pp. 393–402, 4 figs., 1 map, 17 refs. London, 1949.

Measures used in 1943 for the control of *Anopheles gambiae* Giles in the Wadi Halfa area of the Anglo-Egyptian Sudan have already been described [*R.A.E.*, B **33** 203–204]. In 1944 and 1945, control was intensified and extended southwards into the Second Cataract to reduce the risk of spread of *A. gambiae* into Egypt and facilitate its extermination in the Wadi Halfa area. It was eradicated from Egypt in 1945, and a campaign for its extermination in the Wadi Halfa area was put into operation with success in the winter of 1945–46, when it was already uncommon as a result of routine control. At least 56 miles of river, including irrigated areas and the many islands and channels of the Second Cataract, were freed of it with little more than the normal staff. This is thought to be the first instance of the eradication of this mosquito from an area in the Ethiopian region in which it had apparently occurred for many years.

The chief measure used was the treatment of all probable breeding places between Saras and the northern end of the Cataract with paris green dust once a week from November to March. *A. gambiae* was not seen between Saras and Faras on the Egyptian frontier after June 1945 in spite of the excellent breeding conditions created by the exceptionally high Nile floods of 1946. Larvicide treatment was continued for about 20 miles to the north of Saras until February 1947 and then discontinued, as it had been in April 1946 in the rest of the area. The Wadi Halfa area is free of malaria because no Anophelines exist, apart from a few individuals of *A. multicolor* Camb. in the extreme north.

The river for some 220 miles upstream from Saras, which is a possible source of reinfestation, is described, and other species of mosquitos in the whole area are briefly discussed. The area from Saras to Faras is regarded as a barrier to prevent *A. gambiae* from spreading into Egypt and as a possible indicator of any risk of such a spread. No larvicide work is carried out as it is unnecessary and might mask a return of *A. gambiae*. Each part of the area is inspected several times a month. Trains from the south are sprayed with pyrethrum spray before reaching Wadi Halfa and are treated with DDT to leave a toxic deposit. Aircraft also are sprayed at Wadi Halfa and at southern aerodromes. It is proposed to inspect the date boats that pass each autumn and treat them if necessary. The Saras-Faras barrier is additional to one maintained by the Egyptian authorities between Faras and Aswan.

Papers noticed by Title only.

Chamberlain (W. F.) & Hoskins (W. M.). **The Inhibition of Cholinesterase in the American Roach** [*Periplaneta americana* (L.)] **by organic Insecticides and related Phosphorus-containing Compounds.**—*J. econ. Ent.* **44** no. 2 pp. 177–191, 1 graph, 27 refs. Menasha, Wis., 1951. [See *R.A.E.*, A **39** 307.]

Tuft (P. H.). **The Structure of the Insect Egg-shell** [*Rhodnius prolixus* Stål] **in Relation to the Respiration of the Embryo.**—*J. exp. Biol.* **26** no. 4 pp. 327–334, 2 figs., 4 refs. London, 1950. [See *R.A.E.*, A **39** 297.]

Hassall (A.), Doss (M. A.), Humphrey (J. M.) & Ray (D. H.). **Index-catalogue of Medical and Veterinary Zoology. Part 13. Authors : R to Rzóska.**—pp. [1+] 4055–4348. Washington, D.C., U.S. Dep. Agric., 1951. Price $1.00 (from Supt. Documents). [*Cf. R.A.E.*, B **39** 96.]

[Nikol'skaya (M. N.).] **Никольская (М. Н.). Species of the Genus *Telenomus* (Hymenoptera, Scelionidae), Parasites of the Eggs of Tabanids.** *[In Russian.]*—*Dokl. Akad. Nauk SSSR* (N.S.) **62** no. 5 pp. 729–732, 2 figs., 4 refs. Moscow, 1948.

A description is given of the adults of both sexes of *Telenomus oophagus*, sp. n., which was bred from the eggs of *Tabanus* spp. in the Republic of Kara-Kalpak, south of the Aral Sea in Central Asia, together with a key to this and the four other species of *Telenomus* that parasitise the eggs of Tabanids. These are *Telenomus benefactor* Crwf. from *Tabanus taeniola* P. de B. in the Anglo-Egyptian Sudan and *T. biguttatus* Wied. in Nyasaland, *Telenomus kingi* Crwf. from *Tabanus kingi* Austen in the Sudan, *Telenomus tabanivorus* (Ashm.) from *Tabanus atratus* F. in the United States and *Telenomus tabani* Mayr from *Tabanus* sp. in Germany, Austria, European Russia and Kara-Kalpak.

Kohler (C. E.). **Filariasis Control by DDT residual House Spraying, Saint Croix, Virgin Islands. I. Operational Aspects.**—*Publ. Hlth Rep.* **64** no. 27 pp. 857–862, 4 refs. Washington, D.C., 1949.

Brown (H. W.) & Williams (R. W.). **II. Results.**—*T. c.* pp. 863–875, 1 fig., 5 refs.

The operation described in this paper was the first attempt to use deposits of DDT in houses to control *Culex fatigans* Wied. (*quinquefasciatus* auct.) and so prevent transmission of *Filaria* (*Wuchereria*) *bancrofti*. It consisted of spraying the interior of buildings on the island of St. Croix in the Virgin Islands with 5 per cent. DDT in solutions or emulsified solutions to leave a deposit of 200 mg. DDT per sq. ft. The topography and climate of the island, the housing conditions and the method of treatment are described in the first part. Rain water stored in containers of various kinds is the chief source of domestic supply, and sanitation is primitive. The walls of many houses have absorbent surfaces. Four successive applications of spray, each completed in 4–5 months, were made by a crew working continuously from 9th October 1946 to 10th May 1948. The cost is discussed.

The results of the spraying campaign are given in the second part, and the technique of mosquito collection and examination is described. The percentage of houses in which *C. fatigans* was found was reduced from 67 in 1946 to 28 in 1948. The number of adults of this species found fell by 50 per cent., but the average number per house in the houses that harboured the species was not greatly changed. *Aëdes aegypti* (L.) was plentiful in 1946, and 2·3 per cent. of the females dissected contained developing filariae (presumably *F. bancrofti*) but it was absent from the houses in 1948. The percentage of females of *C. fatigans* dissected that contained developing filariae fell from 7·9 to 3·65 and the percentage of those positive containing infective stages from 5·1 to 0. A large proportion of those examined in 1948 contained recently ingested microfilariae. This suggests that many females were not living long enough for the filariae to mature.

The rate of infection with *F. bancrofti* in children and the average microfilaria count both fell during the campaign, and though the differences were not quite statistically significant, and the prepatent period of *F. bancrofti* is long, it appeared that the spraying was already beginning to affect transmission. The initiation of a campaign to control filariasis by treatment of every individual on the island made it useless to continue this study.

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HOCKING (B.). **Further Tests of Insecticides against Black Flies (Diptera : Simuliidae) and a Control Procedure.**—*Sci. Agric.* **30** no. 12 pp. 489–504, 4 pls., 1 fig., 11 refs. Ottawa, 1950.

Investigations of the value of insecticides for the control of the immature stages of Simuliids [*cf. R.A.E.*, B **38** 143] were continued at Churchill, Manitoba, and near Whitehorse, Yukon Territory, in 1948 and 1949 [*cf.* also **38** 51, 167]. The species near Whitehorse are thought to have included *Simulium* (*Eusimulium*) *costatum* Friederichs and *Prosimulium hirtipes* (Fries) in most of the smaller streams and *S. arcticum* Mall. in the rivers. *S. venustum* Say was the dominant species near Churchill. Notes are given on individual streams, showing features of special interest. Various formulations of DDT, parathion, γ BHC (benzene hexachloride), methoxy-DDT (methoxychlor), aldrin [1,2,3,4,10,10-hexachloro - 1,4,4a,5,8,8a - hexahydro - 1,4,5,8 - diendomethanonaphthalene], dieldrin[1,2,3,4,10,10 - hexachloro - 6,7-epoxy - 1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] and 1,2,4-trichlorobenzene were tested in the field for toxicity to the larvae and pupae of several species. The last is a breakdown product of BHC. Except in one experiment, all exposures were for 15 minutes, and all concentrations except those of BHC are of the technical material. In laboratory tests, parathion in wettable-powder suspension caused 98 per cent. mortality of eggs (probably of *S. venustum*) at 0·5 part per million and BHC in emulsified solution caused 96 per cent. mortality at 1 p.p.m. γ isomer. Against larvae in the field tests, DDT in oil solution remained by far the most satisfactory insecticide. It gave excellent control at 0·14 p.p.m. for 10 minutes or 0·07–0·1 p.p.m. for 15 minutes. The other materials were usually applied at higher concentrations, and none of them was consistently effective, though dieldrin, BHC and parathion gave good control in some tests, and trichlorobenzene was the only one that showed no larvicidal action. Parathion, trichlorobenzene, aldrin and BHC showed some toxicity to pupae, but the practical value of this and of the ovicidal activity is doubted. BHC in oil solution stimulated emergence.

DDT, BHC and parathion were tested on the fry and adults of several species of fish, and had no apparent permanent effects at the dosages needed to kill Simuliid larvae, but newly hatched fry are likely to be far more susceptible. Observations on the effects of all the insecticides except DDT on other fauna in the treated streams are recorded. The results do not suggest that any of them are more specific than DDT in their toxicity to Simuliid larvae, but 1,2,4-trichlorobenzene has a lower general toxicity than the others.

A dispenser for the convenient and accurate application of insecticides to streams by a method involving gravity flow from a tank fitted with a globe valve and a manometer connected across an orifice plate, is described in an appendix, and simplified instructions for its use are given. None of the wettable powders, with the possible exception of methoxy-DDT, suspended well enough in the stream water to allow of their application with this dispenser.

MOULE (G. R.). **The Sheep Blowfly Problem in Queensland. 1. Blowflies and their Breeding Habits. 2. Blowflies in Relation to their Environment.**—*Qd agric. J.* **72** pt. 3 pp. 169–175. Brisbane, 1951. **3. The Attractiveness of Sheep to Blowflies. 4. Seasonal Conditions in Relation to Blowfly Strike.**—*T.c.* pt. 5 pp. 281–287, 2 maps.

MILLER (S. J.). **5. Modern Methods of Blowfly Control.**—*Op. cit.* **73** pt. 1 pp. 51–60. 1951.

In the first two parts of this paper, the species of primary and secondary blowflies involved in myiasis of sheep in Queensland are briefly described, and notes are given on their life-cycles, the seasonal distribution of the adults, and

the relative importance of the environments available to the larvae (carrion and living sheep). The factors that render sheep susceptible to infestation, and the relation of seasonal conditions to it are the subjects of the third and fourth. The abundance of the flies and the susceptibility of sheep are both influenced by seasonal conditions. An evenly distributed rainfall ensures the emergence of large numbers of adult flies, the intensity of the rainfall governs the amount of moisture in the fleece, and the evaporation and temperatures affect the rapidity with which the fleece dries. A map is given showing the number of wet months (estimated on the basis of rainfall and evaporation) likely to occur in summer and winter in the different parts of Queensland, and another showing the number of months with a mean maximum temperature of 95°F. or over. In the north-west, the long, hot summers tend to depress fly activity and, in conjunction with the unreliable rainfall, make the importance of blowflies less than elsewhere.

Measures for reducing inherent predisposition and immediate susceptibility to infestation and the treatment of cases that have occurred are reviewed in the fifth part. It is concluded that predisposition should be reduced by correct docking (*R.A.E.*, B **37** 1), Mules' operation (**32** 142) and the tail strip operation (**37** 2). Shearing and crutching should be arranged to precede fly waves, which occur in the autumn and late spring. If this is not possible, jetting (**37** 2) is necessary. Modern insecticides such as DDT and BHC (benzene hexachloride) play an important part in the prevention of head strike and body strike. Cases of infestation are normally treated by dressings (**33** 51), but if they are too numerous for this, BHC may be used to advantage.

Munroe (E. G.). **Pest Trichoptera at Fort Erie, Ontario.**—*Canad. Ent.* **83** no. 3 pp. 69–72, 3 refs. Ottawa, 1951.

In many parts of the St. Lawrence drainage system, and particularly along the upper reaches of the Niagara River, enormous numbers of Trichoptera emerge during the summer and become a pest in a considerable area bordering the water. They swarm in open areas, especially around trees and lights, enter houses and settle in large numbers on walls and other surfaces. They evoke allergic reactions in hypersensitive individuals. Details are given of three collections of Trichoptera comprising some 10,700 adults and 1,450 larvae and pupae in all, made by various means in and near Fort Erie, Ontario, in July and August 1950. More than half the catch was identified and was found to comprise 23 determined species, all commonly found in rapidly flowing water, and possibly two undescribed species. The abundance and period of capture is given for each of the 23 species. *Hydropsyche bifida* Wlk. comprised over 70 per cent. of the catch.

Fredeen (F. J. H.), Rempel (J. G.) & Arnason (A. P.). **Egg-laying Habits, overwintering Stages, and Life-cycle of** *Simulium arcticum* **Mall. (Diptera : Simuliidae).**—*Canad. Ent.* **83** no. 3 pp. 73–76, 3 refs. Ottawa, 1951.

The following is virtually the authors' summary. Studies carried out along the Saskatchewan River from 1947 to 1950 indicate that *Simulium arcticum* Mall. oviposits generally over the surface of the river water during July. The eggs are laid singly, sink to the bottom, and may become embedded several inches in the sand. The species overwinters almost exclusively in the egg stage. The eggs begin to hatch in the spring soon after the ice clears from the river, and the larvae move downstream and attach themselves to rocks in rapids to complete their development. The control of this Simuliid may need repeated applications of larvicide because its hatching period is very long.

Bailey (N. S.). **The Hovering and Mating of Tabanidae : a Review of the Literature with some original Observations.**—*Ann. ent. Soc. Amer.* **41** (1948) no. 4 pp. 403–412, 25 refs. Columbus, Ohio, 1949.

The following is based on the author's summary. In this paper are brought together the observations of some 20 workers on mating and associated activities in Tabanids. Actual mating is recorded for only 13 species in six genera. Of these, 11 mate between 8 a.m. and noon. The hovering habits of 19 species in five genera have been described. Mating appears to be initiated in the air and is usually completed at rest on vegetation. The swarming flight and hovering seem to have significance in the mating of certain species. Original observations in Massachusetts on the hovering and mating of *Tabanus nigrovittatus* Macq. are included. The fact that 29 males were taken individually while hovering, in conjunction with the data obtained by other observers, indicates that hovering is primarily a male activity. *T. nigrovittatus* dips to the surface of the water in the salt-marsh ditches but is never seen near the flowers that abound there. Two males were taken on the peaty bank of a ditch, apparently sucking ooze.

Fairchild (G. B.) & Hertig (M.). **Notes on the *Phlebotomus* of Panama (Diptera, Psychodidae). IV. *P. atroclavatus* Knab, *P. cayennensis* Floch and Abonnenc, *P. chiapanensis* Dampf and some related Forms from the West Indies and Mexico.**—*Ann. ent. Soc. Amer.* **41** (1948) no. 4 pp. 455–467, 26 figs. Columbus, Ohio, 1949.

With the exception of *Phlebotomus atroclavatus* Knab, the species dealt with in this paper, which is the fourth of a series on the *Phlebotomus* of Panama [*cf. R.A.E.*, B **39** 53, etc.], all have a comb-like row of cibarial teeth. This is unusual in New-World species. They comprise *P. chiapanensis* Dampf, *P. cayennensis* Floch & Abonnenc, and *P. ctenidophorus*, sp. n., which is described from a single female from Mexico and is included because it appears to be closely related to *P. cayennensis*. *P. chiapanensis* was found in fair abundance in Panama, and a male and a female were also taken in Costa Rica. Characters distinguishing it from *P. cayennensis* are given. Descriptions are here given of the female and the male genitalia of the typical form of *P. cayennensis*, which is known to occur in French Guiana and Venezuela and was abundant in Panama in crevices in ruins, in a concrete-walled ground-floor room, and in holes and buttresses in trees. It is believed to feed on lizards. Three new subspecies of this species are also described, *puertoricensis* from Porto Rico, *viequesensis* from Vieques Island, Porto Rico, and *maciasi* from Mexico and Guatemala.

The identity of the specimens identified as *P. atroclavatus* in the U.S. National Museum is reviewed. The species was described from Trinidad [**1** 234], but only the male lectotype, labelled "holotype", belongs to it. The associated female, as well as several females from Venezuela, are *P. cayennensis*, which is often found with *P. atroclavatus* in Panama. The male labelled "paratype" and four males from Venezuela are close to or identical with *P. trinidadensis* Newst. *P. guadeloupensis* Floch & Abonnenc and *P. tejeraae* Larrousse are considered synonyms of *P. atroclavatus* [**38** 137]. The species is defined. It is quite abundant in holes and crevices in the walls of the ruins of Old Panama and has also been taken in a wooden building, a cave and buttresses of trees, always near the sea.

Smith (A. H.) & Douglas (J. R.). **An Insect Respirometer.**—*Ann. ent. Soc. Amer.* **42** no. 1 pp. 14–18, 1 fig., 7 refs. Columbus, Ohio, 1949.

A detailed description is given of the construction and use of an apparatus for measuring the oxygen consumption of insects of about the size of the

house-fly [*Musca domestica* L.], by noting the position of an index oil droplet in a calibrated capillary communicating with a sealed chamber containing the insect. The results of a trial made with house-fly larvae are given as an example.

FRICK (K. E.). **The Biology of *Microvelia capitata* Guerin, 1857, in the Panama Canal Zone and its Role as a Predator on Anopheline Larvae (Veliidae : Hemiptera).**—*Ann. ent. Soc. Amer.* **42** no. 1 pp. 77–100. 1 fig., 8 refs. Columbus, Ohio, 1949.

The following is based on the author's summary. The semiaquatic Veliid, *Microvelia capitata* Guér.-Mén., was found abundantly during the dry season in sunny, drying streams in the Panama Canal Zone, where larvae of *Anopheles pseudopunctipennis pseudopunctipennis* Theo. were also plentiful. It appeared likely that the bugs were predacious on the Anopheline larvae, and this was confirmed by laboratory investigations in 1945, when four generations were reared between the middle of April, in the dry season, and the middle of August, well into the wet season, on larvae of *Anopheles albimanus* Wied. No other food was offered, but small cockroaches and Collembola that fell into the water were eagerly attacked.

The egg stage lasted 6–7 days, regardless of season. The nymphs usually passed through five instars and completed their development in periods ranging from about three weeks in the dry season to a fortnight in the wet season. Nymphs of the five instars consumed, respectively, 16 and 17 newly hatched and 15, 14·5 and 16 older first-instar Anopheline larvae. About 50 per cent. of the adults collected in the field or reared in large pans, and higher percentages of those reared in small vials, were apterous. Males lived for 43–93 days and females for 31–79 days in the adult stage, and they consumed large numbers of Anopheline larvae of various instars. They never ate Anopheline eggs. The average egg production per day of females kept with males was 3·6–7·2. Nearly all the eggs laid by mated females were fertile. Only infertile eggs were laid four days after the death of the male. Eggs were laid just below the surface of the water, generally on the edges of the containers but also on floating débris. Eggs more than three days old could withstand drying for 24–48 hours but younger ones could not unless they were only partly dried and in a very humid atmosphere.

NOLAND (J. L.), LILLY (J. H.) & BAUMANN (C. A.). **A Laboratory Method for rearing Cockroaches, and its Application to Dietary Studies on the German Roach.**—*Ann. ent. Soc. Amer.* **42** no. 1 pp. 63–70, 2 figs., 14 refs. Columbus, Ohio, 1949.

An apparatus is described for rearing groups of *Blattella germanica* (L.) for nutritional and other physiological studies. It has given reproducible results for over a year. It consists of a series of cage units fixed side by side on a rack. Each unit comprises a large horizontal test tube (25 × 200 mm.) with the rounded end cut off and replaced by fine wire cloth, a small test tube inside the large one to hold the food, and a medium-sized inverted test tube as a water reservoir, connected with the large tube by bent glass tubing passing through the two corks. The opening at the bottom end of the tubing is constricted to a diameter of 3 mm. by heating so that the water does not leak from it. Three modifications of the basic design for special purposes are described. By increasing the size suitably, the apparatus can be used for *Periplaneta americana* (L.) or *Blatta orientalis* L. About five nymphs are kept in each cage for experimental purposes or one pair of adults for breeding. Food and water are changed weekly.

Groups of nymphs of *Blattella germanica* fed on pulverised dog biscuits or a mixture of pulverised dog biscuits, maize oil and cholesterol matured in averages of 40±2 days and 39±3·1 days, respectively, whereas nymphs fed on two synthetic diets matured at averages of 55 ± 4·7 days and 49±3·1 days. The average weights at 30 days were 42 and 45 mg., respectively, on the two natural diets and 25 mg. on the synthetic diets. Seasonal and genetic variations in growth rate were not significant, but growth appeared to be more uniform in inbred strains than in first-generation cockroaches from natural populations. The average weight of nymphs at 30 days showed roughly twice the variability of the average age at maturity, probably because of sexual differences in weight. The average age at maturity is a useful index of the biological performance of *B. germanica* as modified by diet, as it is not significantly affected by sex.

Noland (J. L.), Lilly (J. H.) & Baumann (C. A.). **Vitamin Requirements of the Cockroach** *Blatella germanica* **(L.).**—*Ann. ent. Soc. Amer.* **42** no. 2 pp. 154–164, 1 graph, 17 refs. Columbus, Ohio, 1949.

The following is virtually the authors' summary. A basic synthetic diet is described on which *Blattella germanica* (L.), *Periplaneta americana* (L.) and *Blatta orientalis* L. grew faster than on dog biscuits, the best crude diet tested. However, reproduction by cockroaches fed on this synthetic diet was inferior to that by those fed on dog biscuits.

The requirements of *Blattella germanica* for the B vitamins was studied by the omission of each singly from the synthetic diet. The omission of choline, pantothenic acid or nicotinic acid resulted in extremely slow growth and death before maturity was reached. The omission of pyridoxin, thiamin or riboflavin resulted in retarded but significant growth, and increased mortality, but some individuals reached maturity. The omission of inositol, para-aminobenzoic acid, manadione (vitamin K) or biotin usually had no adverse effect on growth rate or survival, and the omission of folic acid seemed to stimulate growth somewhat. *B. germanica* reared on a synthetic diet extremely poor in riboflavin accumulated more of this vitamin than was present in the diet ingested. It is suggested that it was synthesised by intestinal micro-organisms.

Jenkins (D. W.). **Trombiculid Mites affecting Man. IV. Revision of** *Eutrombicula* **in the American Hemisphere.**—*Ann. ent. Soc. Amer.* **42** no. 3 pp. 289–318, 15 figs., 25 refs. Columbus, Ohio, 1949.

In this fourth paper of a series [*cf. R.A.E.*, B **39** 141], an attempt is made to clarify the status of the Trombiculids known to attack man in the American hemisphere. It is based on collections made in tropical and temperate areas, examination of the type specimens of 18 of the 25 related species that had been described, often inadequately, and rearing of nine kinds in the laboratory. As a result of this work, 13 species were found to fall in synonymy, leaving six recognisable species and one sub-species and five insufficiently described species that are of uncertain status, as suitable specimens were not available for study. The recognisable species and subspecies are placed in *Eutrombicula* (type *alfreddugèsi* (Oudm.)), which is considered a subgenus of *Trombicula* and is redefined on the basis of both larval and adult characters. *Acariscus* is not considered distinct from *Eutrombicula* [*cf.* **37** 61]. It is proposed that species previously placed in *Eutrombicula* and *Acariscus*, with two prongs on the palpal claw, the outer of which is smaller, be referred to *Trombicula, sensu lato.*

The recognisable forms are *T. multisetosa* (Ewing), *T. batatas* (L.) (*pastorae* Boshell & Kerr, *brasiliensis* Ewing), *T. splendens* Ewing (*masoni* (Ewing) [**39** 141]), *T. alfreddugèsi* (Oudm.) (*similis* (Hirst), *irritans* var. *uruguayensis*

André, *vanommereni* Schierbeek, *butantanensis* Da Fonseca), *T. alfreddugèsi* subsp. *tropica* Ewing, *T. goeldii* (Oudm.) (*helleri* (Oudm.)) and *T. tinami* (Oudm.). These are redefined, and keys are given to their larvae and the adults where known, together with distributional and host records and notes on importance. All except *T. tinami* have been recorded from man, the first doubtfully, the others definitely. *T. tinami* is a Brazilian species known from the larva only. It is apparently closely related to *T. goeldii*. The species of doubtful status are somewhat similarly dealt with, except for keys. They are *T. japa* (Ribeyro & Bambarén) and *T. lahillei* (Sig Thor & Willman), which are known to attack man, and *T. ophidica* Da Fonseca, *T. coarctata* (Berl.) and *T. manriquei* Ewing, which are not.

Grayson (J. McD.). **Response of the German Cockroach to sublethal Concentrations of DDT and Benzene Hexachloride.**—*J. econ. Ent.* **44** no. 3 pp. 315–317, 1 fig., 4 refs. Menasha, Wis., 1951.

Strains of the German cockroach [*Blattella germanica* (L.)] of which the adults of each generation had survived immersion in suspensions of DDT or BHC (benzene hexachloride) usually at concentrations that gave 75 per cent. kill or more were reared through seven generations in the laboratory. The concentrations of DDT needed for 50 and 95 per cent. mortality of females and (in brackets) males were 14·3 (2·3) and 7·8 (4) times as great for the seventh generation of the DDT-treated strain as for the untreated control strain. Adults of both sexes of the strain treated with BHC were only slightly more resistant to this insecticide in the seventh generation than those of the untreated strain. There was a consistent tendency in the fourth and subsequent generations for the average numbers of nymphs per female and nymphs per egg case produced in the strain treated with DDT to be lower than in the other two strains, but the differences were not significant. It is expected that significance will be demonstrable after more data have been obtained in subsequent generations. The width and length of empty egg cases produced in the seventh generation by females of the DDT-treated strain and the length of those produced by females of the BHC-treated strain were significantly less than the corresponding measurements of egg cases produced by females of the untreated strain.

King (W. V.). **Repellents and Insecticides available for Use against Insects of Medical Importance.**—*J. econ. Ent.* **44** no. 3 pp. 338–343, 49 refs. Menasha, Wis., 1951.

Work on repellents against arthropods that attack man is reviewed from the literature, and lists are given of compounds that appear particularly promising against mosquitos, ticks, fleas and Trombiculid larvae, respectively, and are considered safe for use on outer clothing, showing which are commercially available. All remained effective for at least ten days (usually much longer) after the clothing had been treated, and withstood wear of the garments for several days. Treatment was usually at 2 gm. repellent per sq. ft. cloth. Methyl N,N-diisopropyladipamate and 2-butyl-2-ethyl-1,3-propanediol remained highly effective against mosquitos for periods up to 149 days of ageing and 56 hours of wear. Dimethyl phthalate and 2-ethyl-1,3-hexanediol withstood 27 days of ageing and 16 hours of wear. Two of the best compounds against *Anopheles quadrimaculatus* Say were 2,4-nonanediol and dimethyl phthalate. N-butylacetanilide has been the most consistently effective in numerous field tests against *Amblyomma americanum* (L.) and has also been tested against *D. andersoni* Stiles [*cf. R.A.E.*, B **39** 10]. It also repels mosquitos and fleas. The materials that protect against Trombiculids are acaricides rather than repellents. Garments treated with diphenyl carbonate, benzil and p-tolyl

benzoate remain highly effective after six or more launderings. These compounds are also useful in dusting powders. Benzyl benzoate alone and mixed with an equal quantity of dibutyl phthalate was used to protect troops against the Trombiculid vectors of tsutsugamushi disease in New Guinea and the Philippines during the war.

Recent developments in insecticides against arthropods of medical importance are also summarised, those considered in most detail being DDT, DDD (dichlorodiphenyldichloroethane), methoxy-DDT (methoxychlor), chlordan, benzene hexachloride and toxaphene.

LINDQUIST (A. W.), YATES (W. W.), HOFFMAN (R. A.) & BUTTS (J. S.). **Studies of the Flight Habits of three Species of Flies tagged with Radioactive Phosphorus.**—*J. econ. Ent.* **44** no. 3 pp. 397–400, 3 refs. Menasha, Wis., 1951.

An experiment on the use of radioactive phosphoric acid (containing P^{32}) administered orally as a means of marking flies for dispersal studies was carried out in an agricultural area in Oregon in 1950. The flies were marked by confining them in lots of 1,000 with 12 ml. tap water containing 20 microcuries of P^{32} and a small amount of sugar on the day before release, and radioactivity tests before release showed that about 90 per cent. gave readings of 200–5,000 counts per minute. Of some 36,000 released adults of *Musca domestica* L., 15,000 of *Lucilia* (*Phaenicia*) *sericata* (Mg.) and 1,200 of *Phormia regina* (Mg.), 4·6, 3·62 and 14 per cent., respectively, were recovered in 24 traps baited with decomposing liver and fermented sugar and water. These encircled the release point at distances of 0·5, 1, 2, 3 and 4 miles on the first day, after which the nearest traps were moved farther out. *M. domestica*, *L. sericata* and *P. regina* were recovered 12, 4 and 8 miles from the centre. Most of the recovered flies were taken on the first day and in the nearest traps, but radioactive flies had reached a distance of 4 miles in each cardinal direction from the point of release within 24 hours. The ratio of radioactive to non-radioactive flies caught in the traps was 1 : 11 for *M. domestica*, 1 : 70 for *Lucilia* (*Phaenicia*) spp. and 1 : 758 for *Phormia regina*. *P. regina*, *Lucilia* spp. and *M. domestica* comprised about 50, 15 and 7 per cent., respectively, of all flies caught. About 90 per cent. of the *Lucilia* were *L. sericata*. Traps set in barnyards caught several times as many flies (particularly *M. domestica*) as those set in open fields. It is concluded that the use of radioactive phosphorus has been shown to be a satisfactory means of marking flies and that the work involved in examining large catches is considerably less than when pigmented dusts are used.

HIXSON (E.) & MUMA (M. H.). **Stable Fly Control on Dairy Animals with Piperonyl Butoxide-Pyrethrins.**—*J. econ. Ent.* **44** no. 3 pp. 401-404, 2 figs., 12 refs. Menasha, Wis., 1951.

Accounts are given of tests of sprays containing pyrethrins and piperonyl butoxide for the control of *Stomoxys calcitrans* (L.) on dairy cattle in eastern Nebraska in 1949 and 1950. They were designed to confirm the effectiveness of such formulations [*cf. R.A.E.*, B **37** 161] and to determine the maximum interval that can safely be left between applications under local conditions. An emulsion concentrate comprising 10 gm. technical piperonyl butoxide, 1 gm. pyrethrins, 12·5 gm. emulsifier and 76·5 gm. deodorised base oil, diluted 1 : 15 with water, and a wettable powder containing 10 per cent. technical piperonyl butoxide and 0·75 per cent. pyrethrins in inert carriers, suspended in water at 1 lb. per 2·5 U.S. gals., were used in 1949 and the emulsion only in 1950. In 1949, sprays were first applied with a power sprayer at 2 U.S. quarts per animal at intervals of 6–8 days, then daily in small quantities with

a hand mist sprayer and finally daily at 0·5 U.S. pint with a compressed-air sprayer. In 1950, herds received 0·5 pint spray per animal applied with a compressed-air sprayer daily or on alternate days or 2 U.S. quarts applied with a power sprayer once or twice a week.

Comparable results were obtained in the two years and with the suspensions and emulsions. The weekly treatments reduced the number of flies somewhat but did not prevent fluctuations similar to those occurring on unsprayed animals and could not be considered effective. Treatment twice weekly or more often gave effective control, causing highly significant reductions in the numbers of flies and preventing any major fluctuations in populations. Differences between fly populations on herds sprayed twice weekly and on alternate days, and on alternate days and every day, were not significant. Temperature, wind and the position of the test animals affected fly populations, but light did not. Within the range of temperatures involved (60–87°F.), populations were larger under calm or slightly windy conditions. There were more flies on cattle in a barnyard than on those on pasture.

Travis (B. V.) & Smith (C. N.). **Mosquito Repellents selected for Use on Man.** —*J. econ. Ent.* **44** no. 3 pp. 428–429, 8 refs. Menasha, Wis., 1951.

Less than 0·3 per cent. of the several thousand chemicals that have been tested in the last nine years as repellents against the insects that bite man were both sufficiently effective to warrant more than preliminary tests and safe enough for unrestricted use on the skin [*cf. R.A.E.*, B **37** 115 ; **38** 99–100, 118 ; **39** 4, 133, etc.]. They have little or no odour and remain effective much longer than essential oils, but vary in their usefulness against different species and on different individuals. Mixtures are effective against more species and on more individuals than single repellents. The average results are given of tests of 14 repellents that are deemed safe for use on man and of mixtures of 6 parts dimethyl phthalate and 2 parts Indalone with 2 parts of each of the other 12 against *Aëdes aegypti* (L.) and Alaskan species of *Aëdes* [**39** 133] and with the individual repellents and the mixture containing 2-ethyl-1,3-hexanediol (the standard 6 : 2 : 2 mixture) against *A. taeniorhynchus* (Wied.) and *Anopheles quadrimaculatus* Say also, and the mixture containing dimethyl carbate against *A. quadrimaculatus*. The evaluation of all materials was based on the time elapsing between application and the first bite. The most promising single materials against the various species of *Aëdes* were propyl N,N-diethylsuccinamate, 2-ethyl-1,3-hexanediol and dimethyl carbate. Dimethyl phthalate was the most effective against *Anopheles quadrimaculatus*. The mixture containing dimethyl carbate gave good protection against *Aëdes aegypti* and Alaskan *Aëdes*. The standard 6 : 2 : 2 mixture was highly effective against all species. In addition to the mixtures in the list, others containing 1 part each of dimethyl phthalate, Indalone and 2-ethyl-1,3-hexanediol or 2 parts dimethyl phthalate and 1 part 2-ethyl-1,3-hexanediol or 1 part dimethyl carbate are satisfactory for use as repellents.

Bushland (R. C.). **Attempts to utilize Mosquito Larvae in a Bioassay Method for Insecticide Residues in Animal Products.**—*J. econ. Ent.* **44** no. 3 pp. 421–423, 6 refs. Menasha, Wis., 1951.

The determination of the extent to which meat and milk may be contaminated as a result of the application of insecticides to livestock is important

in estimating their value ; there are sufficiently accurate methods of chemical analysis for some of the chlorinated hydrocarbons, but not for others, such as chlordan and toxaphene. As all the chlorinated hydrocarbons known to be effective against livestock pests are highly toxic to mosquito larvae and are easily tested against them in acetone-water suspension, it was thought that these larvae might be used for bioassay, but the results of unpublished experiments by C. C. Deonier & E. H. Peek showed that DDT was rendered relatively non-toxic to mosquito larvae when as little as 10 per cent. whole milk was added to the water in which it was dispersed, and that the toxic effects of chlordan and lindane [at least 99 per cent. γ benzene hexachloride] were also reduced. Further investigations on the subject are described in this paper, the insecticides used being DDT, DDD (TDE [dichlorodiphenyldichloroethane]), methoxy-DDT (methoxychlor), lindane, chlordan and toxaphene.

When chlorinated hydrocarbons contaminate milk, they are found only in the butterfat, and attempts were therefore made to determine whether the substance interfering with insecticidal action would be eliminated by removing the other components of milk. Butterfat was decanted from melted butter and emulsified with sorbitan trioleate and polyoxyethylene sorbitan trioleate (8 : 1 : 1) in warm distilled water, and tests with fourth-instar larvae of *Aëdes aegypti* (L.) showed that most of them could survive for 24 hours in an emulsion containing 4 per cent. butterfat. When emulsions of butterfat containing 25 parts per million of the various insecticides were tested, those containing up to 4 per cent. butterfat and 1 p.p.m. insecticide all failed to kill the larvae. In an attempt to separate the insecticides from the interfering substances in butterfat, samples containing 25 p.p.m. insecticide were dissolved in chloroform, treated with a mixture of sulphuric acid and fuming sulphuric acid and washed with acetone after the evaporation of the chloroform [*cf. R.A.E.*, B **38** 136]. The acetone washings were diluted with distilled water to contain 0·25 p.p.m. insecticide and compared at that and further dilutions with standard acetone-water suspensions against the larvae. DDT and DDD samples subjected to acid extraction killed no larvae at the highest concentration, though the standards caused complete mortality at that and lower concentrations, and it seems that a turbidity that occurred when acetone washings of butterfat extracts were added to water but not when the standard acetone solutions were added, was caused by a substance that interfered with the toxicity of these insecticides. Acetone washings of butterfat contaminated with 25 p.p.m. lindane caused a similar turbidity, but the samples were toxic to the larvae, and comparison with standard acetone solutions of the insecticide indicated that lindane in butterfat was completely recovered after acid extraction. The results suggest that the biological method was sufficiently sensitive to detect 0·5 p.p.m. lindane in milk containing 4 per cent. butterfat. Chemical methods are more accurate. In similar tests with butterfat containing 25 p.p.m. toxaphene or chlordan, neither insecticide could be detected in the extract at a theoretical concentration of 0·25 p.p.m., but the standard dilutions of these materials in acetone were also ineffective at this concentration, and it was concluded that the larvae were not susceptible enough to toxaphene and chlordan to be used in bioassay.

To test a modification by H. V. Claborn of the method for separating insecticides from beef fat [*cf. loc. cit.*], chlordan was dissolved in melted beef tallow to give concentrations of 1–8 p.p.m., subjected to the treatment with chloroform, sulphuric acids and acetone and tested against larvae of *Anopheles quadrimaculatus* Say. The extracted samples appeared to be about as toxic as the standards, but there was high mortality of larvae exposed to acetone washings of fat containing no chlordan, and further tests must be made before conclusions can be drawn regarding the efficiency of the method.

KNIPLING (E. F.). **Insecticides for Livestock Pest Control. Lindane and Toxaphene are recommended as Sprays on Livestock other than Dairy Animals—repeated Applications found non-toxic.**—*Soap & sanit. Chem.* **26** no. 6 pp. 130–131, 133, 135, 155, 157, 2 figs., 3 refs. New York, N.Y., 1950.

Work carried out in the United States on the value of several new insecticides for the control of flies and other pests on livestock is reviewed [*cf. R.A.E.*, B **39** 7, 61, 63, 120, 121, 139], partly because of the issue in the spring of 1949 of recommendations that DDT should not be applied to dairy cows [*cf.* **39** 7]. Pyrethrum at 2 U.S. quarts per cow of a spray containing 0·05 per cent. pyrethrins without a synergist is stated to have given protection from stable flies [*Stomoxys calcitrans* (L.)] for three days in tests in screened stalls. In the field, it is effective for about half as long. Methoxy-DDT (methoxychlor) as a 0·5 per cent. spray decreases biting for 2–3 days. Repellency is not complete, but most of the flies that feed die as a result of contact with the deposits. No treatment is known that lasts long enough to be generally practical for the protection of range cattle.

Toxaphene, chlordan and lindane [containing at least 99 per cent. γ BHC (benzene hexachloride)] are effective against most of the important ticks affecting livestock, including the lone star tick [*Amblyomma americanum* (L.)], the winter tick [*Dermacentor albipictus* (Pack.)], the Gulf Coast tick [*A. maculatum* Koch], the ear tick [*Otobius megnini* (Dugès)] and the cattle tick [*Boophilus annulatus* (Say)]. Lindane is the most effective against all stages present on animals. It kills all forms at 0·03 per cent. or less, but does not provide lasting protection and is therefore best in combination with some other insecticide. Toxaphene at 0·5 per cent. kills all stages and protects animals from reinfestation for two weeks or longer according to the species of tick. Chlordan has given comparable results against three species on which it has been tested. Methoxy-DDT, DDD (TDE [dichlorodiphenyldichloroethane]) and DDT used alone are generally unsatisfactory, because the engorged ticks are resistant to them.

One application of a spray containing 0·5 per cent. DDT, chlordan, toxaphene, DDD or methoxy-DDT or 0·03 per cent. lindane generally gives practical control of the short-nosed cattle louse [*Haematopinus eurysternus* (Nitzsch)] or the long-nosed cattle louse [*Linognathus vituli* (L.)], but eradication is seldom accomplished because of imperfect coverage. DDT at 1·5 per cent. and methoxy-DDT at 1 per cent. gave complete control of the tail louse [*H. quadripertusus* Fahrenholz] on cattle in Florida, and a spray of 0·05 per cent. pyrethrins and 0·5 per cent. piperonyl butoxide gave complete control of the motile forms of this louse in the south-east and of *H. eurysternus* in Texas. Lice on goats are readily controlled with dips containing 0·2–0·25 per cent. DDT [**37** 119, 161–162], DDD, methoxy-DDT, toxaphene or chlordan. BHC dips containing 0·025–0·03 per cent. γ isomer also give good control. Toxaphene and chlordan appeared to be better than DDT, methoxy-DDT or DDD for the control of the pig louse [*H. suis* (L.)] [*cf.* **37** 83], and BHC at 0·025 per cent. γ isomer controlled it well but did not eradicate it. Complete control of the sheep ked [*Melophagus ovinus* (L.)] can be effected with dips of the new insecticides or rotenone [**38** 94], but sprays are less successful unless the wool is less than 2 ins. long [**38** 95]. Good results have, however, been obtained in warm weather with thorough applications of sprays containing 0·5 per cent. chlordan, toxaphene or DDT, or 0·05 per cent. γ BHC [*cf.* also **38** 155].

Experiments on the occurrence of lindane in the milk of sprayed dairy cows or cows housed in sprayed barns [**39** 82], on the storage of insecticides in the fat of beef cattle [**39** 81] and on their acute toxicity to calves [**39** 4] are reviewed. It is concluded that toxaphene and lindane can apparently be used in sprays on

livestock without causing loss if care is exercised over formulation and mixing, but cannot be safely used as dips, until formulations have been developed that will remain stable under adverse conditions.

In conclusion, the new recommendations of the Bureau of Entomology and Plant Quarantine are summarised. Lindane is recommended as a spray to leave a toxic deposit for the control of flies [**39** 120], for use on dairy cows at a maximum concentration of 0·03 per cent. for louse control (since only one or two applications per year are needed for this purpose), and as a spray for the control of other pests on livestock other than dairy animals. Specific formulations of it have also been approved for registration as a drug for use on dairy cows for the control of mange mites. Toxaphene is recommended as a spray for livestock other than dairy animals, particularly for the control of lice, ticks, horn flies [*Siphona irritans* (L.)] and *Melophagus ovinus*.

SCHROEDER (H. O.). **Piperonyl Butoxide in Low Pressure Aerosol Insecticides. Combinations of Piperonyl Butoxide and Pyrethrins when used alone or with DDT permit a marked Reduction in the Amount of Pyrethrins required for both Knockdown and Kill of House Flies.**—*Soap & sanit. Chem.* **26** no. 6 pp. 145, 147, 148A, 148C, 4 refs. New York, N.Y., 1950.

The following is based on the author's summary. The results of tests against house-flies [*Musca domestica* L.] with low-pressure aerosols [*R.A.E.*, B **38** 205] containing combinations of piperonyl butoxide and pyrethrins are reported. All the aerosols contained 15 per cent. nonvolatile materials and 85 per cent. propellent (a mixture of equal parts of Freon 11 [trichlorofluoromethane] and Freon 12 [dichlorodifluoromethane]). Piperonyl butoxide and pyrethrins were used at ratios of 2·5 : 1, 5 : 1 and 8 : 1 and 2 per cent. DDT was included in some formulae. When the concentration of piperonyl butoxide and pyrethrins was adjusted so that the combined cost of the two was essentially the same for each ratio, differences in knockdown and mortality were insignificant. When piperonyl butoxide was added to an aerosol containing pyrethrins and DDT, the concentration of pyrethrins could be reduced by more than half without reducing knockdown after 15 minutes' exposure. Various combinations of piperonyl butoxide and pyrethrins without DDT gave a knockdown far superior to that effected by the Tentative Official Test Aerosol [**39** 6] (containing 2 per cent. DDT and 0·4 per cent. pyrethrins) and equal or higher mortality. Data are given to show that the omission of heavy base oil from aerosol formulae containing only piperonyl butoxide and pyrethrum is highly desirable [*cf.* **38** 206–207].

HERTIG (M.) & FAIRCHILD (G. B.). **The Control of *Phlebotomus* in Peru with DDT.**—*Amer. J. trop. Med.* **28** no. 2 pp. 207–230, 4 figs., 1 map, 9 refs. Baltimore, Md., 1948.

This is a very detailed account of experiments made in Peru in 1945 and 1947 on the possibility of controlling sandflies (*Phlebotomus*) by applying DDT to leave a toxic residue on specified surfaces over an area. The DDT was applied as a 5 per cent. solution by weight in kerosene, and coverage was at about 1·5 U.S. gals. per 1,000 sq. ft. The various methods used for estimating sandfly populations are described. Loose stone walls laid without cement were the principal outdoor shelters of the sandflies, and undoubtedly included breeding places. The first experimental work was done in June and July 1945 in a village in the Rimac valley where the predominant species was *P. verrucarum* Tns., with small numbers of *P. peruensis* Shannon. More or less isolated houses or groups of houses were used. Treatment of the stone walls for a distance of about 15–75 yards round a house reduced sandfly populations markedly, and

treatment of the houses in addition to stone walls reduced them to an extremely low level. The effect of this treatment persisted after 12–19 months, but the results were closely restricted to the sprayed areas, sandflies occurring in normal numbers in houses or caves 75–200 yards away.

Practical control programmes in the camps of two large construction undertakings gave extremely high degrees of control, followed by the virtual cessation of new cases of cutaneous leishmaniasis [*cf. R.A.E.*, B **32** 41] or bartonellosis [*cf.* **31** 82]. At the first site, in the Santa Eulalia Valley, where the sandflies were nearly all *P. verrucarum*, most of the workers had become immune from bartonellosis, which had formerly been severe, but there were 15–20 new cases of cutaneous leishmaniasis per month. At the first treatment in July 1945, only certain selected outdoor structures and objects were sprayed, but three months later and subsequently, all buildings inside and outside were also treated. A year after the last application, no sandflies were found in walls known to harbour them before spraying, and the cases of cutaneous leishmaniasis under treatment had fallen to about four in October 1945. In the camps of the other undertaking, in the Santa River Valley, where a previous survey had shown *P. verrucarum* to be abundant, bartonellosis was very severe. One camp was chosen, and DDT was applied to loose stone walls and boulders for a distance of 50 yards in July 1945, to outer windows and doors also in October and November 1945 and January 1946, and to the inside of the walls of buildings in subsequent treatments in March, April and May 1946. There had been 11 cases of bartonellosis between March and July 1945, but there were only three later cases, possibly not acquired locally. By February 1946, the interiors of all buildings over a very wide area in the Santa River Valley were being treated at intervals of four months, and no locally acquired bartonellosis occurred after April of that year. No sandflies were found in sprayed buildings.

Analysis of the results in terms of the habits and life-history of *Phlebotomus* supports the theory that practical control could be achieved by methods applicable to many of the *Phlebotomus*-infested regions of the world. The sandflies can be denied their sources of blood-meals and their principal outdoor shelters and breeding places. Their flight habits make them vulnerable to DDT deposits throughout their adult life, and the long life-cycle delays recovery of a depleted population.

WADDELL (M. B.) & KUMM (H. W.). *Haemagogus capricornii* **Lutz as a Laboratory Vector of Yellow Fever.**—*Amer. J. trop. Med.* **28** no. 2 pp. 247–252, 14 refs. Baltimore, Md., 1948.

Shannon, Whitman & Franca isolated yellow-fever virus by bite and injection from Brazilian mosquitos that they collected in two localities in the State of Rio de Janeiro and thought to be *Haemagogus capricorni* Lutz [*R.A.E.*, B **27** 121]. No distinction had been made at that time between *H. capricorni* and *H. spegazzinii* Brèthes, but Cerqueira & Lane, who examined a male from their material [**35** 121], believed that *H. capricorni* was indeed the species used. This is not certain, however, as recent collections of mosquitos in the two localities have confirmed the presence of *H. capricorni* in one of them, but in addition have shown *H. spegazzinii* to occur in the other. The Colombian *Haemagogus* found infected in nature and first identified as *H. capricorni* [**32** 184 ; **33** 112] was later found to be more closely related to *H. spegazzinii* and was designated *H. s. falco* Kumm, Osorno & Boshell [**37** 26]. The Brazilian species with which Antunes & Whitman obtained transmission in the laboratory [**26** 65] was also later shown to be *H. spegazzinii* [**37** 144]. In view of the confusion between the two species and the consequent absence of proof of the ability of *H. capricorni* to transmit yellow fever, experiments were made in the laboratory with Brazilian females of this species, the identity of which

was established by examination of the terminalia of their male offspring. They were allowed to engorge on marmosets while virus was circulating in these animals and were then kept in individual vials at 20–22°C. [68–71·6°F.] except for 4–5 hours each weekday when they were exposed to 30–31°C. [86–87·8°F.]. After about 14 days, they were allowed to feed singly on mice every 3–4 days. Seven females, the identity of which was subsequently confirmed, as well as five others, probably of the same species, that produced no male offspring, transmitted the infection. The extrinsic incubation period varied from 14 to 22 days, but no attempt to transmit was made at less than 14 days.

PERRY (W. J.). **The Dengue Vector on New Caledonia, the New Hebrides, and the Solomon Islands.**—*Amer. J. trop. Med.* **28** no. 2 pp. 253–259, 10 refs. Baltimore, Md., 1948.

The potential vectors of dengue in the islands of the South Pacific are discussed, and evidence gathered in 1942–45 is produced to show that the distribution of the disease and that of *Aëdes aegypti* (L.) in New Caledonia, in the New Hebrides (Efate and Espiritu Santo) and in the British Solomon Islands were closely parallel, that the incidence of the disease fell when the mosquito was controlled, and that no cases occurred where it was eradicated or absent. It is concluded that *A. aegypti* is paramount as vector in these islands [*cf. R.A.E.*, B **39** 69]. *A. scutellaris* (Wlk.) (*hebrideus* Edw.) is considered to be the important vector in New Guinea [**37** 181–182], but it did not appear to transmit the disease in nature under normal conditions in the New Hebrides [but *cf.* **39** 69, etc.]. It did not become adapted to man-made catchments to any extent on Efate, but it did so on Espiritu Santo and was sufficiently plentiful there to allow of its transmitting dengue after the control of *A. aegypti* had it been biologically able to do so. *A. albopictus* (Skuse), the only other known vector [**36** 174], has not been recorded from any of the islands from New Caledonia through the Solomon chain.

YOUNG (M. D.), HARDMAN (N. F.), BURGESS (R. W.), FROHNE (W. C.) & SABROSKY (C. W.). **The Infectivity of native Malarias in South Carolina to *Anopheles quadrimaculatus*.**—*Amer. J. trop. Med.* **28** no. 2 pp. 303–311, 1 fig., 2 refs. Baltimore, Md., 1948.

The work described in this paper was designed to provide information on the transmission of malaria in an endemic area and was carried out in South Carolina in 17 consecutive months in 1945–46. Females of *Anopheles quadrimaculatus* Say were allowed to feed in batches, usually of about 100, on negroes with locally acquired malaria infection, and then kept either in an insectary or in an outbuilding or shelter and dissected after 8–10 days or longer. Of 142 batches (containing 12,606 females) fed on those infected with *Plasmodium falciparum*, 21 showed infections, and of the 6,500 females from these batches that were dissected, 163 showed gut or gland infections or both. The infections were generally light but they developed normally in the mosquito, and transmission was successfully effected in one out of two trials. Infections occurred in June, August and October–January, inclusive. Mosquitos kept in outdoor shelters during October and November became infected even though the minimum temperature fell to 23°F. in November. One person remained infective to mosquitos for eight months. Of the 25 showing gametocytes, 16 infected mosquitos. The gametocyte densities resulting in infections were relatively low, none being over 90 per cu. mm., and 13 batches of mosquitos acquired infection when there were less than 10 gametocytes per cu. mm. [*cf. R.A.E.*, B **25** 185]. The two persons with the highest gametocyte counts (121 and 165 per cu. mm.) did not infect mosquitos. Of persons with demonstrable parasites, those who had no symptoms infected mosquitos at about the

same rate as those who had. As the former are much the more numerous, it seems apparent that they are mainly responsible for transmission.

Of 14 batches of mosquitos fed on ten persons infected with *P. malariae* (four of whom showed gametocytes of a low density at the time of feeding), three batches became infected, and of 586 mosquitos dissected, 10 were infected. One man was responsible for the three infected lots over a period of six months. The gametocyte counts were consistently low. Of nine batches fed on persons who had previously shown *P. vivax* in the blood-smears, none became infected. No gametocytes were present.

It is concluded that persons without symptoms and usually with a relatively low gametocyte density are the important factor in the transmission and maintenance of malaria caused by *P. falciparum* and *P. malariae* in the area studied.

FLETCHER jr. (O. K.) & KRAUSE II (J. B.). **Mass Destruction of Adult Anophelines by DDT as a suggested Malaria Control Measure. A preliminary Report.**—*Amer. J. trop. Med.* **28** no. 2 pp. 323–332, 7 refs. Baltimore, Md., 1948.

Data are given to show that in southern Georgia, where the people expose themselves to risk of malaria infection by remaining out-of-doors during darkness, the suppression of the non-domestic population of *Anopheles quadrimaculatus* Say is of great importance, that this can be effected by adequate use of larvicides, but only at great cost in time and materials, that termination or restriction of their application was generally followed by a marked rise in the numbers of the Anopheline, and that introduction of spraying of all occupied dwellings with DDT was never followed by a fall in the numbers collected outdoors except in one locality where there was a steady reduction over the seven years regardless of any measures taken. The failure of the DDT treatment to affect the outdoor population is in contrast with the results obtained by Trapido against *A. albimanus* Wied. in Panama [*R.A.E.*, B **37** 213].

To test the possibility of reducing the numbers of Anophelines in natural resting places outside human habitations by applying sprays of DDT to leave a toxic residue to these places, an experiment was carried out in July and August 1946 in which all favoured resting sites found over an area of 16 sq. miles (barns, stables, hen-houses, eaves, hollow trees, logs, barrels, etc.) were sprayed with 5 per cent. DDT in emulsified solution. The amount used was 247 U.S. gals. Occupied houses in the area had been sprayed a few weeks earlier. The cost of the new measure was about a fifth of that of treating the breeding-places of the area with Paris green or three-fifths of that of treating them with DDT or spraying occupied dwellings. Anophelines were scarce before treatment, and collections yielded an average of only 12·9 adults (mostly *A. quadrimaculatus*) per shelter per search. From the time of treatment until the end of the season, only one adult was found in the sprayed shelters. An average of 2·37 Anophelines per collection per index station was obtained from untreated artificial shelters in the period following treatment and 40 per collection per index station from similar artificial shelters outside the treated area. Comparison with untreated areas indicated that populations of larvae (including *A. crucians* Wied., *A. quadrimaculatus* and small numbers of *A. punctipennis* (Say)) were reduced by 89·1 per cent. The reduction in larvae of *A. quadrimaculatus* was estimated to be 95·3 per cent.

It is concluded that mass destruction of Anophelines by spraying their natural resting places with DDT may appreciably modify the production potential for the area and that the method is more economical and effective than treating houses or using larvicides and merits further study.

Burgess (R. W.). **The experimental Hybridization of** *Anopheles quadrimaculatus* **Say and** *Anopheles maculipennis freeborni* **Aitken.**—*Amer. J. Hyg.* **48** no. 2 pp. 171–172, 3 refs. Lancaster, Pa., 1948.

Experiments are described in which adults of *Anopheles quadrimaculatus* Say and *A. maculipennis freeborni* Aitken were given the opportunity to interbreed in the laboratory in cages having a capacity of about 1 cu. ft. Females of either form mated with males of the other and laid fertile eggs, but only 2 per cent. of the eggs hatched when the females were *A. quadrimaculatus*, whereas 30·3 per cent. hatched with the opposite cross. All the larvae were small and weak, and none survived beyond the third instar.

Woodman (H. M.). **Filaria in the Anglo-Egyptian Sudan.**—*Trans. R. Soc. trop. Med. Hyg.* **42** no. 6 pp. 543–558, 4 pls., 2 figs., 1 map, 47 refs. London, 1949.

Work on filariasis in the southern Anglo-Egyptian Sudan is summarised [*cf. R.A.E.*, B **23** 134 ; **30** 77 ; **39** 66], and the findings are compared with those of neighbouring countries. All authentic records of *Filaria* (*Wuchereria*) *bancrofti*, *F.* (*Loa*) *loa*, *F.* (*Acanthocheilonema*) *perstans* and *Onchocerca volvulus* come from the southernmost provinces of Equatoria and Bahr-el-Ghazal, except for one focus of *F. bancrofti* recently found in the Nuba Mountains. The distribution of each in the Sudan is described, and brief notes are given on the identification of the three blood parasites under field conditions. The only proved vectors of *F. loa* are *Chrysops distinctipennis* Aust. and *C. longicornis* Macq., which occur in the ratio of 26 : 1 [*cf.* **30** 78]. Development in them is compared with that in *C. silacea* Aust. and *C. dimidiata* Wulp in Nigeria as described by Connal & Connal [**10** 42], and evidence is produced indicating that they are perhaps not the best or commonest vectors in the Sudan.

A survey of the incidence of *O. volvulus* on the southern fringes of the area of endemic blindness in Bahr-el-Ghazal was made near breeding places of *Simulium damnosum* Theo. and where onchocercal eye conditions were rare and cases of nodules seen only occasionally. It revealed skin infection in up to 77 per cent. of the population. Apparently, the skin can become considerably infected with the microfilariae before, or during, the formation of nodules and without affection of the eyes [*cf.* **39** 66]. Data from the literature on the degree to which infection with *O. volvulus* in the Belgian Congo and in Kenya is associated with the pathological conditions to which it is believed to give rise are tabulated.

Preventive measures against infection with any of the filariae consist in avoiding contact with the vectors where these are known, and it is possible that DDT can be used against the larvae of *S. damnosum*. Notes are given on the therapeutic use of certain drugs, and skin antigen tests with material prepared from avian filariae are described.

Papers noticed by Title only.

Mahaffy (A. F.). **The Epidemiology of Yellow Fever in central Africa** [mainly a review of work in Uganda].—*Trans. R. Soc. trop. Med. Hyg.* **42** no. 6 pp. 511–524, 2 maps, 25 refs. London, 1949. [*Cf. R.A.E.*, B **39** 132, etc.]

Hassall (A.), Doss (M. A.) & Humphrey (J. M.). **Index-catalogue of Medical and Veterinary Zoology. Part 14. Authors : S to Shweig.**—pp. 4349–4676. Washington, D.C., U.S. Dep. Agric., 1951. Price $1.25 (from Supt. Documents). [*Cf. R.A.E.*, B **39** 160.]

Shepard (H. H.). **The Chemistry and Action of Insecticides.**—9¼×6 ins., vii+504 pp., 22 figs., many refs. New York, N.Y., & London, McGraw-Hill Book Co., Inc., 1951. Price $7.00 or 59*s.* 6*d.* [See *R.A.E.*, A **39** 353.]

Fleck (E. E.). **Report on DDT** [methods of determination].—*J. Ass. off. agric. Chem.* **31** no. 2 pp. 368–372, 9 refs. Washington, D.C., 1948.

Stoker (W. J.) & Koesoemawinangoen (R. W.). **Illustrated Map of the Anopheline Imagines of Indonesia (English Translation).**—15¾×11½ ins., 69 pp., text illus. Djakarta, Minist. Hlth Indonesia (Sect. Malar. Contr.), 1949.

The principal characters, relation to malaria and breeding places of each of the 66 species and varieties of *Anopheles* and six of *Bironella* known in the adult stage from Indonesia are indicated, and figures are given of the mouth-parts, wings and legs and the abdomens and male hypopygia of some of them.

Strode (G. K.). Ed. **Yellow Fever.**—10×7¼ ins., xv+710 pp., 1 col. pl., 76 figs., 34 pp. refs. New York, N.Y. & London, McGraw-Hill Book Co., Inc., 1951. Price $9.50 or 81*s*.

This comprehensive work includes chapters by various contributors of which the first is entitled "Landmarks in the Conquest of Yellow Fever", others are concerned with the virus, pathology, immunology, and clinical aspects and diagnosis, and several deal with transmission and control. In the first of the latter, "The Arthropod Vectors of Yellow Fever" by L. Whitman (pp. 229–298), factors that affect the ability of mosquitos to acquire and transmit the infection, the distribution of the virus in an infected mosquito, the relation of temperature and humidity to its incubation period in it, the capacity of different strains to develop in mosquitos, the possibility of virus passage from mosquito to mosquito, the amount of virus necessary to infect mosquitos, the effect of immune serum on virus already in a mosquito, the relation of mosquito ecology and habits to the transmission of yellow fever, the species of mosquitos of interest in relation to yellow fever in South America and in Africa, and the isolation of other viruses from mosquitos caught in nature are all discussed, and investigations on the possibility that other Arthropods act as vectors of yellow fever are very briefly reviewed.

Animals serving as vertebrate hosts in South America and in Africa are reviewed in "The Mammalian Host in Yellow Fever" by J. C. Bugher (pp. 299–384). The chapter on "Epidemiology" by R. M. Taylor (pp. 427–538) is an extensive account of the factors that contribute to the spread and persistence of the disease in man, other vertebrate hosts and mosquitos. The characteristics of yellow-fever virus that have epidemiological significance are reviewed, the epidemiological concepts of host and vector are defined, and laboratory adjuncts to epidemiological investigations are described. The man-mosquito cycle in America, with notes on the bionomics of *Aëdes aegypti* (L.), and in Africa, with notes on the bionomics of *A. aegypti* and *A. simpsoni* (Theo.), the forest or animal-mosquito cycle, with notes on technique and on probable vectors and hosts in South America and Africa, and jungle or sylvan yellow fever (the disease in man contracted by the bite of a sylvan mosquito) in both continents are discussed at some length. There are also notes on the past and present geographical distribution of yellow fever and a discussion of the probable place of origin.

The chapter on "Controlling Yellow Fever" by H. H. Smith (pp. 539–628) contains brief descriptions of early anti-mosquito campaigns in Cuba, Brazil, Mexico, Panama and the United States, and accounts of attempts to eradicate the disease completely by exterminating *A. aegypti* (which were shown to be impracticable by the discovery of other important vectors), the use of immunity tests and viscerotomy in the search for new bases of control, modern methods of prophylaxis by vaccination and control of *A. aegypti*, and international measures. "Costs and Man Power" are discussed in a final brief chapter by G. K. Strode (pp. 629–639).

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LEWIS (D. J.). **The Simuliidae of the Anglo-Egyptian Sudan.**—*Trans. R. ent. Soc. Lond.* **99** pt. 14 pp. 475–496, 1 pl., 14 maps, 37 refs. London, 1948.

The general distribution of Simuliids in the Sudan is discussed, and a list is given of the 14 described species (all of the genus *Simulium*) known to occur there. There is also one undescribed species of the same genus. Information is given on the distribution of each, and the Simuliid populations of various areas, particularly the south-east and the north, are discussed. The only species known to attack man in the Sudan are *S. damnosum* Theo. and *S. griseicolle* Becker, but a few species that do so elsewhere are also present. *S. damnosum* is troublesome in many parts of the Sudan and is probably the vector of *Onchocerca volvulus*, the cause of human onchocercosis in some areas [*R.A.E.*, B **39** 66]. It breeds mainly in rapids [*cf.* **36** 147] but also in quite calm water flowing at about 1·25 miles per hour, and it has been found in many of the larger streams, the rapids of many rivers and some of the navigable parts of the main and Blue Niles. In the south, pupae are sometimes found in large numbers on the cords used to anchor fish traps in rapids as well as on plant growth on rocks and stranded plant fragments. They have been taken at a depth of 2 ft. The adults have great powers of flight and prefer wooded to open country, but they are common in the barren, rocky desert near the Fourth Cataract and have been found biting in places devoid of vegetation in several northern areas. They have been seen to attack donkeys.

S. griseicolle is widely distributed along the lower parts of the main and Blue Niles and has been found in a few places in the south. It breeds chiefly in rivers rather than streams and usually in unbroken water, the surface most used being moderately hard mud in water flowing at as little as 0·5 mile per hour, though the larvae and pupae have also been found on submerged stones, sticks and similar objects. Dense clusters of pupae were found 2½ ft. below the surface.

Adults of both sexes rest on vegetation in large numbers. They can travel considerable distances, possibly helped by wind. The males frequent and apparently feed on mango flowers. The females normally feed little on man, but cause intense annoyance in the Dongola area because of their immense numbers. They walk over the skin and probe for some time, though relatively few become engorged. They readily feed to repletion on birds and donkeys, often causing the death of the former and occasionally of the latter. They bite during twilight but not after dark. The measures used locally for personal protection are the application of sesame oil to the skin and the wearing of smouldering rope on the head. Smoke is also used to protect animals. The large-scale use of repellents may prove the most practicable means of alleviation, in view of the excessive cost of using insecticides. Preliminary field tests with undiluted dimethyl phthalate gave promising results against both *S. griseicolle* and *S. damnosum*.

ESKEY (C. R.), PRINCE (F. M.) & FULLER (F. B.). **Transmission of *Salmonella enteritidis* by the Rat Fleas *Xenopsylla cheopis* and *Nosopsyllus fasciatus*.**—*Publ. Hlth Rep.* **64** no. 30 pp. 933–941, 3 refs. Washington, D.C., 1949.

An account is given of experiments in which *Xenopsylla cheopis* (Roths.) and *Nosopsyllus fasciatus* (Bosc) acquired *Salmonella enteritidis*, one of the agents responsible for outbreaks of acute gastroenteritis, by feeding on mice infected by subcutaneous inoculation, and subsequently transmitted the infection to other mice by their bites. Many fleas excreted all the *Salmonella* organisms in their first faecal deposits after exposure to infection, but others retained them for periods of up to eight weeks, and 50 per cent. of *X. cheopis* and 66·6 per cent. of *N. fasciatus* retained infection until they died or were killed. No individuals of *X. cheopis* that remained infected until death lived

more than 40 days, and the average time was 24 days. *N. fasciatus* was more resistant ; 38 per cent. of individuals of this species survived infection for more than 40 days and 18 per cent. for more than eight weeks. Many infected fleas of both species developed symptoms of an inflammatory condition of the gastro-intestinal tract, and the efforts of many to feed were much prolonged, particularly in *X. cheopis*. Microscopic evidence of infection is described.

Of mice on which 3–15 infected fleas were fed individually, one of 15 exposed to *X. cheopis* and seven of 43 exposed to *N. fasciatus* became infected, and all these died of the infection. No fleas defaecated on five of the mice and it may be assumed that these mice were infected by bites. The mechanism by which the flea infects its host by its bite is unknown, but regurgitation from the oesophagus is probably involved. A summary is given of four experiments that resulted in the infection of mice by infected fleas. Some transmission tests made by placing batches of up to ten fleas on mice and keeping the mice separately in jars for 5–6 weeks are also described. One of 13 mice exposed to *N. fasciatus* and 2 of 11 exposed to *X. cheopis* became infected. No infection was found at the end of the test in the few fleas of both species that survived.

Babers (F. H.) & Culpepper (G. H.). **The Effect of 2-Pivalyl-1,3-indandione on Body Lice, when administered orally to Rabbit Hosts.**—*J. Parasit.* **35** no. 6 Sect. 1 pp. 551–554, 7 refs. Lancaster, Pa., 1949.

The following is virtually the authors' summary. Laboratory experiments were carried out at Orlando, Florida, to determine the effect of 2-pivalyl-1,3-indandione on *Pediculus humanus humanus* L. (*P. h. corporis* Deg.), when administered orally to rabbits on which the lice were fed [*cf. R.A.E.*, B **39** 88]. Three rabbits received a diet of commercial rabbit pellets to which the chemical had been added in such quantities that the desired dose was contained in 50 gm. feed.

The minimum quantity of 2-pivalyl-1,3-indandione necessary in the daily diet of rabbits to prevent reproduction of lice feeding on them was about 0·15 mg. per kg. body weight. At this dosage, young nymphs allowed two blood-meals daily succumbed within three days. At a dosage of 0·125 mg. per kg., about half the lice reached maturity and a few viable eggs were deposited. Among lice given a single blood-meal on rabbits receiving 0·15, 0·175 and 0·2 mg. per kg., the mortality was much higher in females than in males or nymphs. The nymphs showed decreasing mortality as they became older. The blood of the rabbits remained toxic for only three days after ingestion of the chemical ceased. One rabbit that had received varying quantities over a period of eight months died. No lesions definitely attributable to the chemical were found on autopsy.

Friedman (R.). **The Story of Scabies. Volume I. The Prevalence (Civil and Military), Prevention and Treatment of Scabies, and the Biology of *Acarus scabiei*, from the earliest Times to the Beginning of World War II.**—9¼ × 6¼ ins., xxxi + 468 pp., 114 figs., refs. New York, N.Y., Froben Press Inc., 1947. Price $7.50.

This volume, which is intended to be the first of a series of four, is based on earlier published works by the author including one on the biology of *Sarcoptes* (*Acarus*) *scabiei* (Deg.) that has already been noticed [*R.A.E.*, B **32** 235] and is reprinted in full. The remainder comprises information on the prevention and treatment of scabies and on its prevalence in various groups in the civilian population, in the American armies during the Revolution and the Civil War, in the U.S. Army and Navy at various periods between 1914 and 1938, and in the British and French armies during the first World War.

CAMERON (T. W. M.). **The Parasites of domestic Animals. A Manual for Veterinary Students and Surgeons.**—2nd edn. (revd. and enlarged), $8\frac{3}{4} \times 5\frac{1}{4}$ ins., xvi+420 pp., col. frontis., 16 pls., 129 figs., 4 pp. refs. London, A. & C. Black, 1951. Price 38*s*.

This monograph, which is concerned mainly with the protozoa and helminths that occur in domestic animals and poultry, has also a chapter on the arthropods of veterinary importance. In this, the habits and control of blood-sucking Diptera (including mosquitos), Oestrids, myiasis-producing blowflies, other non-biting flies, lice, fleas, ticks, mites and venomous arthropods are described, and notes are given on insecticides and their use. The relation of arthropods to the transmission of some of the protozoa and helminths is briefly indicated in the other chapters, and a table is included showing the ticks that transmit species of *Theileria* infecting cattle and *Piroplasma* (*Babesia*) infecting cattle, sheep, horses, goats and dogs, the stages in which they acquire and transmit infection, and whether they are one-, two- or three-host ticks.

SCHARFF (D. K.). **Cattle Grubs—their Biologies, their Distribution and Experiments in their Control.**—*Bull. Mont. agric. Exp. Sta.* no. 471, 74 pp., 8 figs., $18\frac{1}{2}$ pp. refs. Bozeman, Mont., 1950.

The literature on the bionomics of *Hypoderma lineatum* (Vill.) and *H. bovis* (Deg.) and their world distribution, economic importance and control is reviewed at some length, and an account is given of experiments and observations made in Montana in 1949–50. When the study in Montana was begun, great difficulty was experienced in distinguishing between the larvae of the two species in the penultimate instar, and a description is given of certain characters that were found by E. F. Knipling to aid materially in differentiating them. Observations made by the author in 1948 and 1949 on the duration of the period spent by the larvae in the backs of the cattle showed that the first individuals of either species to arrive in the backs remained there for about three weeks longer than did the last to appear. Data are given to show that this variation in development rate can probably be correlated with the amount of heat absorbed each day from the sun by the larvae in the cysts. Year-to-year variations of 30 days in dates of peak abundance of the larvae are seen from the literature to be not uncommon. In any one season, variations of 60 days or more often occurred between individual herds of cattle in the same general area. This was especially true in mountainous parts of Montana. Cattle were found to show various degrees of resistance to *Hypoderma* larvae ; some animals remained almost free from infestation, and the larvae in others died after reaching the back.

The results are tabulated of experiments designed to evaluate some of the currently recommended spray formulae and methods of application, and to improve on them if possible. Beef cattle with average infestations were sprayed at pressures varying from 400 to 600 lb., the spray nozzle being held 6–18 ins. above the back when a cone-shaped spray was used or 2 ins. above when a fan-shaped spray was emitted. No significant difference was noticed between the performance of the two types of spray, though the fan-shaped spray appeared to penetrate the hair better. *H. bovis* was consistently more difficult to kill than was *H. lineatum* [*cf. R.A.E.*, B **38** 3, 152], and kills of more than 80 per cent. of the former species were rare. The results of many experiments were erratic, but the best were obtained with 600 lb. pressure. Spraying the animals twice and massaging their backs vigorously between the two sprayings with a blunt garden hoe slightly increased kills. The application of crude rotenone (ground cubé root) with power sprayers appeared to be the only practical means of control. All rotenone extracts tested were unsatisfactory. The addition of

specific wetting agents showed promise [*cf.* **38** 152]. A spray containing 0·5 per cent. trisodium phosphate, 0·5 per cent. Neutronyx 600 (aromatic polyglycol ether condensate) and no rotenone killed 37 and 100 per cent. of the larvae of *H. bovis* and *H. lineatum*, respectively, but these materials used in combination with cubé were not significantly better than cubé alone. Dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] at 0·25 per cent. was ineffective. Preliminary data show that in parts of Montana, two treatments properly timed should give more than 90 per cent. control of the combined infestations by both species in any herd of cattle that were pastured together in the previous spring and summer.

Hoffman (R. A.), Lindquist (A. W.) & Butts (J. S.). **Studies on Treatment of Flies with radioactive Phosphorus.**—*J. econ. Ent.* **44** no. 4 pp. 471–473, 1 ref. Menasha, Wis., 1951.

Studies on the treatment of house-flies (*Musca domestica* L.) with radioactive phosphorus (P^{32}) were begun in Oregon in August 1949 to determine the possibility of using it to mark flies for flight studies [*cf. R.A.E.*, B **39** 168] and the effect on egg production and subsequent generations of flies. A few preliminary tests were also carried out with the blowfly, *Lucilia* (*Phaenicia*) *sericata* (Mg.). The flies were either fed on sugar solutions containing radioactive phosphoric acid or reared in a medium containing it.

In the preliminary tests, house-flies and blowflies were made radioactive by both methods. House-flies that received large (but undetermined) quantities and gave readings of 70,000–100,000 counts per minute produced few viable eggs, and adults reared from these eggs either did not oviposit or laid eggs that did not hatch. In a few tests, the eggs from flies that gave 5,000–8,500 c.p.m. carried a small part of the isotope (5–32 c.p.m.) into the next generation. Subsequent tests with house-flies and known amounts of P^{32} supported these results. Four groups of flies, A, B, C and D, of which the first two each comprised ten males and ten females, the third ten females and the fourth ten males, were allowed to feed for four days on solutions containing 120, 20, 60 and 60 microcuries P^{32}, respectively. They were then paired and allowed to oviposit, after which they were tested for radioactivity. The females of groups A and B were paired with the males of their own groups, and the flies of groups C and D were paired with untreated ones. The females of group A averaged 95,426 c.p.m. seven days after the test started and although all had oviposited, no larvae hatched. The nine females of group B that survived to oviposit averaged 21,744 c.p.m., but larvae hatched from only four of the nine egg-masses and only 14 pupae developed. From 11 of these, flies that averaged 22 c.p.m. emerged 28 days after the parents had fed on the radio-active solution. Only one batch of eggs was obtained from the females of group C, but 43 pupae developed and 42 flies emerged. The F_1 and F_2 generations of this group produced normal numbers of eggs, and hatching was normal. The males of group D averaged 37,932 c.p.m. All the untreated females that had mated with them oviposited, and 208 pupae were obtained. In rearing tests, in which phosphoric acid solution was introduced into rearing medium in quantities to give 2·4, 1·6, 0·8 and 0·4 microcurie P^{32} per gm., larvae of *M. domestica* developed and pupated normally and adults emerged at the normal time. Radio-activity counts of pupae and adults bore some relation to the concentration of P^{32} in the medium. Pupae gave much higher counts than adults. No abnormalities occurred. Adults of the F_1 generation appeared normal and produced a normal complement of viable eggs, and two of the strains were reared through three generations without observed mutants.

It is concluded that feeding adult flies on a solution containing radioactive phosphorus is the more economical and efficient method of marking with P^{32}.

GERSDORFF (W. A.) & MITLIN (N.). **Joint toxic Action against House Flies in Mixtures of Parathion and its Methyl Homolog.**—*J. econ. Ent.* **44** no. 4 pp. 474–476, 6 refs. Menasha, Wis., 1951.

The relative toxicity to adults of *Musca domestica* L. of parathion, its methyl homologue (O,O-dimethyl O-p-nitrophenyl thiophosphate) and three mixtures of these compounds was determined by testing them as sprays in refined kerosene by the turntable method [*R.A.E.*, B **26** 246]. The methyl homologue was 68 per cent. as toxic as parathion, and 1 : 4, 1 : 1 and 4 : 1 mixtures of parathion and its methyl homologue were, respectively, 72, 88 and 91 per cent. as toxic as parathion. The mortality percentages caused in one day by 100 mmg. per ml. of the two compounds and the three mixtures were 87·9, 55·9, 66·3, 72·2 and 83·6. The action of the compounds when applied jointly was identified as similar action [A **28** 200], since one of them could be substituted for the other in a constant ratio without altering the toxicity of the mixture.

PIMENTEL (D.), DEWEY (J. E.) & SCHWARDT (H. H.). **An Increase in the Duration of the Life Cycle of DDT-resistant Strains of the House Fly.**—*J. econ. Ent.* **44** no. 4 pp. 477–481, 1 graph, 3 refs. Menasha, Wis., 1951.

The life-histories of four strains of *Musca domestica* L. that had been reared from DDT-resistant flies collected in different parts of New York State and showed different degrees of resistance were compared with that of a normally susceptible laboratory strain. Three of the resistant strains had completed two laboratory generations without treatment, but the fourth had had its resistance increased by breeding for five generations from survivors of exposure to DDT that caused 97–99 per cent. knockdown. The resistance of the fifth generation was 10,000 times that of the non-resistant strain, and about 3 per cent. of the flies could survive exposure for 2·5 weeks to a deposit of 4,000 mg. DDT per sq. ft.

The lengths of larval periods of the four resistant strains were significantly longer than that of the susceptible strain, and increased in close relation to the resistance of the various strains to DDT. Flies from larvae of a moderately resistant strain that pupated in the first 48 hours during which pupation occurred were less resistant than flies from larvae of the same strain that pupated in the last 48 hours. No significant differences between the highly resistant strain and the susceptible strain were found in the number of eggs laid, length of egg stage, percentage hatching, length of pupal stage, pupal weights [*cf. R.A.E.*, B **38** 203], sex ratio, pre-oviposition period or length of adult life.

HANSENS (E. J.). **The Stable Fly and its Effect on Seashore recreational Areas in New Jersey.**—*J. econ. Ent.* **44** no. 4 pp. 482–487, 6 refs. Menasha, Wis., 1951.

Stomoxys calcitrans (L.) is a serious pest in the coastal resorts of New Jersey, particularly those on the sand spit that runs southwards for about 25 miles from Point Pleasant. A survey of the prevalence of the adult flies on the ocean beach and the bay shore of the sand spit and on the road between them was made in 1948, 1949 and 1950 by using traps consisting of shingles or metal sheets painted black and coated with an adhesive. The flies were most abundant on the ocean beach in all three years, but though nearly 80 per cent. of the total were taken there, the catches were sporadic and always associated with westerly winds, whereas they were more or less consistent in the other two environments. Flies appeared on the beaches within 15 minutes of a movement of the wind to the west and disappeared just as readily with unfavourable wind. They normally flew within two or three feet of the ground,

and were attracted to dark colours. Breeding took place in deposits of marine vegetation above the high-tide line on the bay shore. Flies emerged from caged weed at the rate of 370 per bushel. The life-history was found to be somewhat longer than in areas farther south [*R.A.E.*, B **33** 147]. *S. calcitrans* bred at temperatures up to 88°F. Other Muscoid larvae were found at higher temperatures. The vegetation was most attractive when it had been out of water only a few days, and the flies often became very numerous 2–4 weeks after very high tides.

Successful control of emerging adults followed the experimental spraying of the surface of piles of weed with 0·5 per cent. DDT, methoxy-DDT (methoxychlor) or DDD (TDE [dichlorodiphenyldichloroethane]) in emulsified solutions. Control was estimated to be 89 per cent. or better with all insecticides. In consequence, community-wide control was tried in 1949 and 1950 at the resort of Seaside Park. All deposits of marine vegetation lying on the bay shore or removed to other parts of the town were sprayed every two weeks in both seasons with 0·5 per cent. DDT or methoxy-DDT applied at 1 U.S. gal. per 200 sq. ft. The control obtained was estimated to be 90–95 per cent. Various methods of application and types of equipment were tested in 1950, and a truck-mounted sprayer with a tank of 200 U.S. gals. capacity and a 3-nozzle boom made possible the speediest and easiest application of spray. The cost, which was low, and the nature of the problem and other possible control measures are briefly discussed.

GRANETT (P.), CONNOLA (D. P.) & LEMBACH (J. V.). **Laboratory Tests of Allethrin for Stability, residual Action and Toxicity.**—*J. econ. Ent.* **44** no. 4 pp. 552–557, 6 refs. Menasha, Wis., 1951.

In tests of allethrin (the synthetic allyl homologue of cinerin I) against third-instar larvae of *Aëdes aegypti* (L.), the median lethal doses, in parts per million, of this compound and (in brackets) of pyrethrins were 0·19 (0·059) and 0·11 (0·05) when acetone solutions or fresh aqueous emulsions were added to the water, and 0·53 (0·65), 0·22 (0·60) and 0·36 (0·59) when emulsions were used after being exposed to ultra-violet light for three hours, to heat (110–120°F.) for three days, and to room conditions for a week, respectively. Allethrin was thus initially less toxic, but far more stable, than the pyrethrins. The addition of five parts of a synergist (either n-octyl sulphoxide of isosafrole or piperonyl butoxide) to one part allethrin or pyrethrins had hardly any effect on toxicity. As a spray at 0·1 per cent. in refined kerosene against house-flies [*Musca domestica* L.], allethrin was superior to pyrethrins when fresh and after exposure to heat or to room conditions and equal to pyrethrins after exposure to ultra-violet light. In view of these findings, the persistence of toxicity of deposits on plywood and glass was tested by exposing house-flies to them for two hours. Deposits on plywood of allethrin from acetone solution or water emulsion at 144 mg. per sq. ft. retained their toxicity for at least three months. Pyrethrins at 144 mg. caused knockdown up to one month after application, but the flies recovered from exposure to such deposits even one week after application. When applied on glass in acetone solution, allethrin was effective for a shorter time than on wood and pyrethrins did not give any appreciable knockdown or kill even after one week. The emulsions were much more effective on glass than the acetone solutions. When applied to plywood in acetone solution with a synergist, allethrin and pyrethrins at 72 mg. per sq. ft. with the sulphoxide were both effective for three months, and allethrin at 28 mg. with piperonyl butoxide was effective for two months, though the pyrethrins were not completely so. Allethrin deposits from emulsions were not so durable on some types of painted surfaces as on unpainted wood, and effectiveness was influenced by the emulsifier used. When deposits of 144 and

72 mg. per sq. ft. from acetone solution were exposed to ultra-violet light for 4–30 hours and tested ten or more days after application, exposure for 20 or 30 hours was necessary to affect the toxicity of the allethrin to house-flies. In this test, the pyrethrins were ineffective even without exposure to ultra-violet light. In a settling-mist test of oil solutions, 4–6 times as much allethrin as pyrethrins was needed to give the same mortality of females of the American cockroach [*Periplaneta americana* (L.)], whereas less than 1·5 times as much was needed against females of the German cockroach [*Blattella germanica* (L.)].

Ball (H. J.) & Beck (S. D.). **The Role of the Circulatory and Nervous Systems in the toxic Action of Parathion.**—*J. econ. Ent.* **44** no. 4 pp. 558–564, 7 refs. Menasha, Wis., 1951.

Tests in which females of *Periplaneta americana* (L.) were treated topically with parathion (dissolved in acetone) showed that there was a direct relation between the distance of the treated area from tissue of the central nervous system and the time required for knockdown, but no correlation between cuticle thickness and knockdown time. Since insects treated over the dorsal blood-vessel had the longest knockdown time, it appeared that the blood was not the only mechanism involved in the movement of the toxic principle of parathion [*cf. R.A.E.*, B **39** 1]. The possibility that removal of a part of the nerve system might delay the reaction of the cockroach to the insecticide was examined. Interrupting the ventral nerve cord by burning in the first, second or third abdominal sternites increased the time between treatment on the third to fifth segments and knockdown, and the time was further increased when the number of burnt areas was increased. The same increase in knockdown time was observed when other nerves between the treated area and central nerve tissue were cut or burnt. Tests in which males were treated topically between the sixth and seventh sternites over the ventral nerve cord and sections of nerve cord were removed immediately before treatment or 5, 10 or 20 minutes after it showed that knockdown time decreased with the increase in time between treatment and removal of nerve tissue.

When nerve, muscle or fat tissue from cockroaches was homogenised and put in parathion emulsion for 12 hours, washed and rehomogenised with small aliquots of benzene to extract the absorbed parathion, the relative knockdown time of adults to which the extracts were applied indicated that nerve tissue absorbs parathion in greater amounts than fat or muscle tissue. The accumulation of parathion in the central nervous system and in other tissues of cockroaches killed at the first appearance of symptoms after topical application was therefore investigated. Chemical analysis and bioassay of benzene extracts of the ventral nerve cords showed no significant amounts of parathion, which suggested that it may be metabolised in nerve tissue, but analysis of extracts of the foreguts showed that they were removing parathion from the blood and that the amount of parathion present was directly related to the time between treatment and dissection. Examination of blood removed from treated insects 15 minutes after treatment showed that it carried small amounts of parathion and might be responsible for the continuous movement of small amounts of parathion from the point of application to the foregut, and when parabiotic connections were made between two cockroaches with the blood as the only tissue contact, parathion applied topically to one insect was detectable in the other at knockdown, giving final proof that the blood was one mechanism for its translocation.

It is concluded that both the central nervous system and the blood were active in translocating the toxic principle of parathion (probably some metabolite) in the insect body, the former being the more effective.

LINDQUIST (A. W.), ROTH (A. R.) & WALKER (J. R.). **Control of the Clear Lake Gnat in California.**—*J. econ. Ent.* **44** no. 4 pp. 572–577, 10 refs. Menasha, Wis., 1951.

Chaoborus astictopus Dyar & Shann. has long been a problem of economic importance in the neighbourhood of Clear Lake, California [*R.A.E.*, B **31** 48]. Laboratory and field studies having indicated that DDD (dichlorodiphenyldichloroethane) is effective in killing larvae of the gnat at concentrations of about 1–2 : 100 million [*cf.* **39** 2], an attempt at practical control was made in September 1949 when about 14,000 U.S. gals. of a solution of 30 per cent. DDD and 10 per cent. emulsifier in xylene was dispersed over the 41,600 acres of Clear Lake by surface craft. This was about 1 part DDD per 70 million parts water. In addition, 20 ponds, reservoirs and small lakes within 15 miles of Clear Lake were also treated. The insecticide flowed undiluted from large drums through small tubes by gravity and was discharged on lines about 700 ft. apart across the lake, as it was believed that wave action and currents would distribute it evenly. Discharge stopped 0·5 or 0·75 mile from the shore to prevent injury to littoral fauna. Subsequent tests of the toxicity of the water to *Chaoborus* larvae indicated that the insecticide dispersed rather slowly towards the shore. Bioassay tests on *Aëdes* larvae indicated that the concentration of DDD in the lake as a whole was less than 1 : 400 million 10–18 days after treatment.

One and two days after treatment, floating *Chaoborus* larvae affected by the insecticide extended for miles over the lake. Sometimes, there were hundreds per square foot. Oviposition was heavy for five days, but the young larvae were apparently killed by the DDD. Hundreds of bottom samples were taken from the lake after the application, but no larvae were found 11 or more days after treatment, and nets drawn through the water at night several months later caught only two larvae, whereas several hundred thousand would have been taken during the previous season. Considerable numbers of adults were seen around lights for nine evenings, but none after the 13th day. No adults were found around the lake during the summer of 1950. It appeared that complete control of *C. astictopus* was accomplished without any apparent harm to other aquatic organisms.

GRAHAM (O. H.) & ALFORD jr. (H. I.). **The Occurrence of *Gasterophilus* spp. in Texas and some Tests with Insecticides for their Control.**—*J. econ. Ent.* **44** no. 4 pp. 577–579, 1 ref. Menasha, Wis., 1951.

Examination between 16th February and 16th August 1950 of the stomachs and duodena of 508 horses slaughtered near San Antonio, Texas, revealed that all but three were infested with the larvae of *Gasterophilus intestinalis* (Deg.), *G. nasalis* (L.) or both, the average number of larvae per horse being 226 with a range of 1–1,659. The animals were in poor condition, partly owing to the infestation and partly because of old age, and most of them were infested with both species. Notes are given on the distribution of the larvae within the stomach and duodenum. There was little change in the average number of bots per horse or the proportion of second to third instars of *G. intestinalis* as the season progressed, but the proportion of second to third instars of *G. nasalis* increased markedly from February to June. There was no change in the proportion of the species, *G. intestinalis* being the more numerous.

In laboratory tests by immersion in solutions, third-instar larvae of *G. intestinalis* were found to be extremely resistant to dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene], aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene], heptachlor [1(or 3a),4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7-endomethanoindene], DDT, methoxy-DDT (methoxychlor),

DDD (TDE [dichlorodiphenyldichloroethane]), BHC (benzene hexachloride), toxaphene, chlordan and parathion. Moreover, no larvae were expelled when horses infested by both species were treated by stomach tube with lindane [containing at least 99 per cent. γ BHC], dieldrin, aldrin, heptachlor, chlordan or distilled pine oil or received lead arsenate in their food. Toluene administered by stomach tube at 20 cc. per 100 lb. body weight freed two horses of their bots, as did carbon bisulphide, the recommended material [*cf. R.A.E.*, B **34** 166], at 2·5 cc. per 100 lb., but there was severe sloughing of the lining of the stomach when carbon bisulphide was used, whereas the stomachs of the horses treated with toluene appeared more nearly normal.

Bartlett (B. R.). **A new Method for rearing *Drosophila* and a Technique for testing Insecticides with this Insect.**—*J. econ. Ent.* **44** no. 4 p. 621, 4 refs. Menasha, Wis., 1951.

The author describes a method of rearing *Drosophila melanogaster* Mg. in numbers on canned custard pumpkin and a modification of a technique of using the adults to test contact insecticides [*R.A.E.*, B **36** 75]. The flies for test are caged on filter papers that have been impregnated with acetone solutions of the insecticides and dried, and the periods for 50 per cent. kill are determined by periodic counts of accumulated mortalities.

Fales (J. H.), Nelson (R. H.), Fulton (R. A.) & Bodenstein (O. F.). **Tests with two insecticidal Aerosols for Use on Aircraft.**—*J. econ. Ent.* **44** no. 4 pp. 621–622, 4 refs. Menasha, Wis., 1951.

A liquefied-gas aerosol formula (G-382) approved in 1948 by the United States Public Health Service for the control of insects in aircraft consists of 5 per cent. pyrethrum extract (20 per cent. pyrethrins), 3 per cent. DDT, 5 per cent. cyclohexanone and 2 per cent. lubricating oil with 85 per cent. dichlorodifluoromethane as the propellent. As some users objected to the cyclohexanone solvent, a new formula (G-651) was developed. It consisted of 6 per cent. pyrethrum extract, 2 per cent. DDT, 8 per cent. methylated naphthalenes and 84 per cent. dichlorodifluoromethane. The results are given of comparative tests of the two made in a Peet-Grady chamber in February 1949. They were similar in performance against *Musca domestica* L., both as regards knockdown and kill, and at 5 gm. per 1,000 cu. ft., the dosage required by the Public Health Service for use in aircraft in the presence of people, both gave complete mortality of *Anopheles quadrimaculatus* Say and *Aëdes aegypti* (L.). G-651 was approved by the Service in March 1949, and both formulae have since been used. It is important that the pryethrum extract in G-651 should not contain more than 1·5 per cent. material insoluble in dichlorodifluoromethane, as a higher content has sometimes caused clogging of the nozzle.

Wharton (R. H.). **The Behaviour and Mortality of *Anopheles maculatus* and *Culex fatigans* in experimental Huts treated with DDT and BHC.**—*Bull. ent. Res.* **42** pt. 1 pp. 1–20, 1 pl., 6 figs., 18 refs. London, 1951.

The following is largely based on the author's summary. Experimental huts lined with smooth brown paper and fitted with louvres through which mosquitos could enter and with window traps and sometimes louvre traps to catch them when they left were used in Malaya in 1948 and 1949 for studying the behaviour and mortality of *Anopheles maculatus* Theo. in relation to DDT and BHC (benzene hexachloride). The insecticides were applied as wettable-powder suspensions with a brush. During experiments, a man occupied each hut from 7 p.m. until 5 a.m. The numbers of adults of *A. maculatus* in the traps were

estimated periodically during the night, and the huts were searched and initial mortality estimated at 8 a.m. Other species of *Anopheles* formed a large proportion of the catch in a man-baited net trap, but rarely entered the huts.

In untreated huts, *A. maculatus* fed at all hours of the night with a peak between 9 p.m. and midnight. The large majority left before 8 a.m. in search of outdoor resting places ; at least 50 per cent. left before dawn. It appeared that attraction to light was the strongest, but not the only, factor influencing exit from the huts. Large numbers of other mosquitos (mostly *Culex fatigans* Wied.) were recovered. In untreated huts, about 80 per cent. had fed on blood and 28 per cent. were in window traps at 8 a.m. An experiment in which 100 mg. DDT or 20 mg. γ BHC per sq. ft. was applied to all the interior surfaces of a hut except the door curtain, louvres and floor was unsuccessful, partly because very small numbers of mosquitos were recovered. No conclusions are drawn from the results, but certain modifications in technique were made in consequence of the findings. These included precautions against removal by cockroaches, spiders, etc., of mosquitos knocked down.

In a second experiment, DDT at 200 mg. and BHC at 40 mg. γ isomer per sq. ft. were both effective for at least 12–16 weeks against *A. maculatus*. The seasonal decline in numbers made it useless to continue observations longer than this. With DDT, corrected initial and 24-hour mortalities of 63 and 83 per cent. were recorded over 10 weeks and 16 weeks, respectively. With BHC, though the initial mortality dropped from 100 per cent. in weeks 1–4 to 19 per cent. in weeks 12–16, mortality after 24 hours, which was almost complete for weeks 1–10, was still 88 per cent. for weeks 12–16. DDT apparently had little effect on the feeding of *A. maculatus*, but BHC reduced the biting rate considerably for six weeks. DDT was practically non-lethal to *C. fatigans*, but had a marked irritant effect, driving the mosquitos into the window trap and reducing the biting rate from about 70–80 to about 45 per cent. BHC caused complete mortality of *C. fatigans* for two weeks, but lost most of its toxic effect by the eighth week. The biting rate was reduced to 27 per cent. for weeks 1–8, and most of the mosquitos were recovered in the trap. The results suggested that BHC when freshly applied repels *A. maculatus* and *C. fatigans* [*cf. R.A.E.*, B **39** 149]. *Mansonia uniformis* (Theo.) was shown to be susceptible to both DDT and BHC deposits.

THOMSON (R. C. Muirhead). **D.D.T. and " Gammexane " as residual Insecticides against *Anopheles gambiae* in African Houses.**—*Nature* **163** no. 4133 pp. 109–110, 4 refs. London, 1949.

Mud-and-thatch African-type huts with window exit traps were used to test the effect of house treatment with DDT in kerosene on Anophelines in Nigeria [*R.A.E.*, B **36** 66], and a considerable irritant effect was revealed and only very short protection from biting was afforded. In a repetition of the experiment in Tanganyika, a hut was treated with DDT as a suspension of a dispersible powder at the rate of 400 mg. powder per sq. ft. Females of *Anopheles gambiae* Giles were feeding in the hut in numbers on the night after treatment ; large numbers of blood-fed females were taken every day from then onwards in the window trap, and mortality among them in 24 hours was not appreciable. No resting Anopheline was found inside the hut for at least two months, but it is unlikely that the mosquitos would be seriously affected by being driven into the open air in East or West Africa. When the inner walls and ceiling of a hut were sprayed with a suspension of BHC (benzene hexachloride) at 1 lb. dispersible powder per gallon water to leave a deposit of about 400 mg. powder (24 mg. γ isomer) per sq. ft., no living Anopheline was found resting in the hut for weeks after treatment and none was taken alive in the trap for 13 weeks, but many were found dead on the floor sheet at every collection throughout that period. Feeding continued to take place in the hut, but many

females were evidently killed before they could bite. After 13 weeks, the falling Anopheline population brought the experiment to a close.

WILKINSON (P. R.). **Distribution and Fate of *Anopheles gambiae* and *A. funestus* in two different Types of Huts treated with DDT and BHC in Uganda.**—*Bull. ent. Res.* **42** pt. 1 pp. 45–54, 3 refs. London, 1951.

Experiments on the effectiveness of deposits of DDT and BHC (benzene hexachloride) against *Anopheles gambiae* Giles and *A. funestus* Giles were made in Uganda in huts of wood and fibre-board adapted from those described by Magoon [*R.A.E.*, B **23** 302], fitted with one-way entry and exit traps and raised on oiled supports to exclude ants, and also in mud huts with window exit traps [*cf.* preceding abstract], which were surrounded by a shallow water-filled channel to exclude ants and a ditch to dry the hut and discourage burrowing ants and termites. One mosquito searcher slept in each wood-and-board hut and two men in each mud hut. The two types of huts were used on alternate nights. Sheets were spread on the floor about 7 p.m., the door was shut for the night at 10 p.m. and dead mosquitos were collected from the floor, and the walls and roof were searched for living ones and the traps examined at dawn. Only female Anophelines were counted. Observations were continued for 16 weeks after spraying, which was carried out on 12th April 1949, with suspensions of dispersible powders. In the huts of the first type, the insecticide was applied to a removable lining of fibre-boards, the DDT at 439 mg. (334 mg. p,p′isomer) per sq. ft., which was believed to be 3·3 times the dosage used by Thomson [see preceding abstract] and the BHC at 273 mg. (35·5 mg. γ isomer) per sq. ft., which was 1·5 times Thomson's dosage. One hut was left as a control, and only one mosquito was found dead in this hut in the observation period, during which DDT caused 97 per cent. kill of *A. gambiae* and complete kill of *A. funestus* and BHC 97 per cent. kill of both species. There was a sharp decrease in the number of mosquitos entering the hut treated with BHC in the weeks immediately after spraying. This might be due to repellent effect or masking of the attractive human odour by the odour of the insecticide. The mud huts were sprayed with 193 mg. DDT (145 mg. p,p′isomer) or 212 mg. BHC (27·5 mg. γ isomer) per sq. ft. No dead mosquitos were found in the control hut during the observation period, and DDT killed 62 per cent. of *A. gambiae* and 78 per cent. of *A. funestus* and BHC 98 per cent. of *A. gambiae* and 93 per cent. of *A. funestus*. Total catches in the treated mud huts were lower after spraying.

The advantages claimed for the wood and fibre-board huts include freedom from ants, which may remove dead mosquitos, ease of catching living mosquitos, rigid construction of exit trap and lack of adventitious exits other than the exit trap.

In a note by K. S. Hocking (p. 54), it is stated that since this paper was written, important differences have been revealed between the DDT wettable powders used by Thomson and Wilkinson. That used by Thomson has a greater proportion of large particles of DDT, which are much less toxic to mosquitos than the smaller ones, would separate out in the drums of powder so that a small sample might not be representative, and would settle rapidly after mixing with water so that the dosage applied to the walls may have been much less than Thomson supposed. Therefore, Thomson's poor results were probably due to a low dosage of a poor formulation.

GLASGOW (J. P.) & DUFFY (B. J.). **Further Observations on the Extermination of *Glossina palpalis fuscipes* Newstead by Hand-catching.**—*Bull. ent. Res.* **42** pt. 1 pp. 55–63, 1 pl., 2 figs., 5 refs. London, 1951.

The experimental block of riverine bush in Kenya from which *Glossina palpalis fuscipes* Newst. was exterminated by hand catching in 1945 [*R.A.E.*,

B **36** 67] and the control block from which it was exterminated in 1947 [**36** 68] were found to be still free in April 1949, when 30 and 27 fly-boys patrolled the respective blocks for eight days. An attempt made to clear a block of wider forest, 1½ miles long, along a large permanent river (20–30 yards wide in dry weather) by the same method was unsuccessful. The block was isolated by clearings of two miles upstream and three miles, later extended to 3½ miles, downstream. Clearing did not increase the rate of soil erosion over an observation period of two years. The cost of effecting it in man-days is given. About 26 teams of two catchers working each day from August 1946 to June 1947 reduced the numbers of tsetse taken from 4,678 in the first four weeks to 111 in the last four. At this time, it was obvious that no further reduction was being made. As more of the catch had been taken from boats than from the land, all riverside catchers worked in boats from July 1947 to April 1948. The catch in the first four weeks was 163, and catches for the subsequent periods fluctuated round this figure with no reduction. Catching of marked flies made it clear that flies were crossing both clearings in sufficient numbers to account for the failure to achieve eradication. Two attempts were made to prevent crossing, one by stretching hessian screens treated with DDT right across the river and the other by placing large numbers of DDT-treated " trap-screens " in the clearings, but neither was successful. There was no evidence that hand-catching would not be successful in a completely isolated block, but it appears to be impracticable to isolate a block of bush of this type on a permanent river.

Brown (A. W. A.), Sarkaria (D. S.) & Thompson (R. P.). **Studies on the Responses of the female *Aëdes* Mosquito. Part I. The Search for attractant Vapours.**—*Bull. ent. Res.* **42** pt. 1 pp. 105–114, 1 pl., 12 refs. London, 1951.

Sarkaria (D. S.) & Brown (A. W. A.). **Part II. The Action of liquid Repellent Compounds.**—*T. c.* pp. 115–122, 1 graph, 8 refs.

An investigation of the factors that attract females of *Aëdes* spp. to warm-blooded hosts was made in view of the heavy infestation of large parts of Canada by mosquitos of this genus. In the first of these papers, which initiates a series on the results of the work, the attractiveness of water-vapour, carbon dioxide and certain attractant compounds is considered. It was studied by the use of an olfactometer with two ports emitting parallel streams of vapours freely into a cage with a capacity of 360 cu. ft. containing 1,000–3,000 adults of *A. aegypti* (L.). The olfactometer and experimental procedure are described.

The following is largely based on the authors' summary of the results. Moist air (85 per cent. relative humidity) attracted 3–5 times as many females as dry air (15 per cent.) and was twice as attractive as no emission [*cf. R.A.E.*, B **37** 57–58]. A moistened billiard-ball attracted about seven times as many females as a dry one, the results being similar whether black or white balls were used. However, the attractancy was reduced and even reversed at very high room humidities. The addition of 10 per cent. carbon dioxide about doubled the ability of a dry air stream to attract mosquitos to within 0·5 ins. of the port of discharge, but did not significantly increase the attractiveness of a moist air-stream. Pure carbon-dioxide vapour proved to be no more attractive than dry air, and several times less attractive than moist air. Various chemical compounds found in body exudations and others known to be attractive to house-flies [*Musca domestica* L.] were tested in the olfactometer at two concentrations, one 100 times the other, for their effect on *A. aegypti*. None was consistently attractive, and many were significantly repellent.

Ethyl alcohol, ethyl butyrate and beer gave on occasion individual counts that appeared to indicate definite attractiveness. Sweat itself proved significantly attractive at a low vapour concentration, but significantly repellent at a high concentration.

In the second paper, the assessment of a number of liquid mosquito repellents for vapour repellency against females of *A. aegypti* in the same apparatus is described. The knockdown power of the repellents in fumigation bottles was also tested. Methods used are described, and the repellency rating, vapour pressure and knockdown speed of 40 repellents are shown in a table. All liquids showed vapour repellency, and 39 of the 42 tested showed highly significant repellency. The compounds already known to be the most effective repellents had the highest ratings, and all fell into the first two of the five classes into which the compounds were grouped. These had repellency ratings of 71–85 and 61–70 per cent., respectively. Although the more volatile compounds, such as citronellal, tended to show the highest ratings, compounds of low vapour pressure, such as Indalone, dimethyl phthalate and isobornyl 4-morpholinoacetate, also showed high vapour repellency, the first two being in class two and the third in class one. The third has proved to be outstanding in lasting effect against mosquitos when used to impregnate clothing. The moderately volatile n-hexyl mandelate was in the first class [*cf.* **38** 102], as were also n-hexyl diethyleneglycol monoether and the standard 6-2-2 mixture (dimethyl phthalate, Indalone and 2-ethyl-1,3-hexanediol). It is concluded that vapour repellency, although in the first instance dependent upon volatility, can vary independently of vapour pressure, so that compounds may be found that afford not only a long protection period due to their low volatility, but also a high vapour repellency due to the potency of the comparatively few molecules that are volatilised. The vapours of all except seven of the repellents induced some knockdown but there was no correlation between the speed of this process and vapour repellency.

Kumm (H. W.) & Cerqueira (N. L.). **The *Haemagogus* Mosquitos of Brazil.**—*Bull. ent. Res.* **42** pt. 1 pp. 169–181, 2 col. pls., 7 figs., 15 refs. London, 1951.

This is a summary of information on the prevalence, distribution and taxonomy of the four species of *Haemagogus* found in Brazil. *H. spegazzinii* Brèthes (or its subspecies *falco* Kumm, Osorno-Mesa & Boshell-Manrique) was found in 114 of the 147 localities surveyed, and is the most abundant species as well as the most widespread. Males were rarely taken in nature [*cf. R.A.E.*, B **37** 26], but identification was made by examination of the terminalia of the male progeny of captured females. *H. capricorni* Lutz and *H. uriartei* Shann. & Del Ponte were taken in 25 and 21 localities, respectively, and *H. tropicalis* Cerq. & Ant. in one. Captures were made in the forest canopy where possible [*cf.* **38** 92]. The four species provided 79·3, 18·3, 2·1 and 0·3 per cent., respectively, of the males examined. This does not give a true picture of the prevalence of *H. uriartei*, which is widely distributed in the dry north-eastern areas, but which can be identified without breeding males. It was generally taken below 1,600 ft. *H. capricorni* was largely confined to the south-eastern States. The distribution of *H. spegazzinii* appeared to be unconnected with altitude. The typical form was found most often near the mouth of the Amazon where the mean annual rainfall exceeds 80 ins. *H. s. falco*, first described from Colombia [**37** 26], was the form found in the western part of the country. Distribution records are given for each species, with notes on nomenclature. A continuous series of intergradations between typical *H. spegazzinii* and *H. s. falco* was found ; however, as the structure of the mesosome of the latter is quite distinctive, the localities in which it has been taken are

indicated separately. A key is given to the male terminalia of the five Brazilian forms, and others are given differentiating the adults and larvae of *H. tropicalis* and *H. uriartei* from each other and from those of the other three. The larva of *H. uriartei* is described for the first time.

Busvine (J. R.) & Wilson (N. F.). **Experiments on the Use of DDT for preventing Bed-bug Infestation of new Houses.**—*Bull. ent. Res.* **42** pt. 1 pp. 185–194, 6 figs., 5 refs. London, 1951.

An experiment was made to determine the effectiveness of DDT treatment of a new house in curbing an infestation of bed-bugs (*Cimex lectularius* L.) introduced with untreated furniture. Two small huts were built of prefabricated sections, and the walls and ceiling of one were sprayed with 5 per cent. DDT in kerosene to leave a deposit of about 170 mg. DDT per sq. ft. A rabbit-hutch infested with 40 bugs represented infested furniture in each hut, and rabbits introduced nightly represented the hosts. The interior of each hut was examined weekly. The bug population in the untreated one rose to over 400 in six months. The population in the treated hut remained at about 20 until the experiment was ended after 28 weeks, and most of the live bugs found in this hut were in the untreated hutch. The numbers of dead bugs in the two huts were not greatly different for five months, after which the number in the untreated hut rose steeply, but the initial death rate of the original adults was higher in the treated hut, and there was probably a greater kill of very young nymphs, the bodies of which are difficult to recover.

It appears from these results that a colony of bugs might persist in an untreated bed in a room sprayed with DDT, but that the destruction of wandering bugs, particularly young ones, would prevent a heavy and widespread infestation. Observations in the untreated hut indicated the decline of the first-generation adults, the rise and decline of the second generation and emergence of the third, during the seven months. A few tests with marked individuals showed that the bugs do not usually return to the same site after leaving it to feed.

Kumm (H. W.) & Cerqueira (N. L.). **The Rôle of *Aëdes leucocelaenus* in the Epidemiology of Jungle Yellow Fever in Brazil.**—*Bull. ent. Res.* **42** pt. 1 pp. 195–199, 1 col. pl., 2 figs., 9 refs. London, 1951.

Aëdes leucocelaenus Dyar & Shannon transmits the virus of yellow fever readily in the laboratory and has been found infected in nature in Brazil and Colombia [*R.A.E.*, B **27** 121 ; **32** 184], but it is not abundant in all of the parts of Brazil in which human cases of jungle yellow fever have been contracted. Except in southern Brazil, it is much less common than *Haemagogus spegazzinii* Brèthes among day-biting sylvan mosquitos caught with human bait. Figures of captures in various areas are given to show this. It is, however, widely distributed throughout the forested part of the country. It has been found in 18 of the 20 States, three territories and the Federal District. The two remaining States have not been thoroughly searched. A list is given of the 124 localities where it has been found, and their positions are shown on a map.

Kemp (P. B.). **Field Observations on the Activity of *Pheidole*.**—*Bull. ent. Res.* **42** pt. 1 pp. 201–206, 4 figs., 4 refs. London, 1951.

The foraging activities of ants of the genus *Pheidole* in different types of country were studied in Tanganyika with particular reference to possible changes in food under conditions of fire exclusion, in view of reports that the ants are important predators on puparia of *Glossina*, particularly in unburnt

bush [*R.A.E.*, B **33** 55, etc.]. The experimental area is briefly described, and the results are given of observations in July and October of the numbers of ants foraging on the surface of the ground. These were made by attracting them to baits of raw meat placed on unburnt grey soil and burnt and unburnt red soil. *P. sculpturata* Mayr and *P. crassinoda* Emery were the most abundant species and were active mainly in the morning and evening. More were collected in July than in October, and more were found on unburnt grey soil than on burnt red soil in both months. The numbers on unburnt red soil were about the same as on burnt red soil in July, but were about as high as on the grey soil in October.

The food of *Pheidole* was mainly grass seeds, and insects apparently formed only a very small part of their normal diet. The amount of grass in unburnt country was shown to be half that found in the sites in country burnt annually. This suggests that there is a reduction in the food available for *Pheidole* under conditions of fire exclusion, with consequent intensification of foraging. It is not known whether the greater numbers of ants attracted to the baits in unburnt country represent a larger ant population.

THOMSON (R. C. Muirhead-). **Mosquito Behaviour in Relation to Malaria Transmission and Control in the Tropics.**—$8\frac{3}{4} \times 5\frac{1}{2}$ ins., viii+219 pp., 16 pls., 22 figs., many refs. London, E. Arnold & Co., 1951. Price 30*s*.

The purpose of this book is to review knowledge on the general behaviour of the species of *Anopheles* that transmit malaria in the tropics and to examine the relation of their activities to their importance as vectors, to the distribution of their breeding places and to modern methods of control, particularly spraying with DDT or benzene hexachloride to leave a toxic deposit. The advent of such lasting insecticides has made it possible to regard the eradication of malaria as the ultimate objective of control operations. The work reviewed was mostly done in the last 15 years.

The book is divided into two parts. In the first, which is concerned with the movements of adults in relation to mating, feeding and resting, observations and experiments are recorded and reviewed in six chapters, dealing, respectively, with general activities in relation to mating, feeding and length of life, nocturnal activity and biting cycles, outdoor resting places and the exodus from houses, host selection, behaviour in relation to temperature, humidity and light, and behaviour in homes in relation to control by insecticides. The second part is devoted to the nature and selection of breeding places. Emphasis here is on the influence of simple physical and chemical factors on the behaviour of the ovipositing female and on the immature stages. The first chapter in this section is a discussion in rather general terms on the choice of the breeding place. The other five are concerned with the effect on ovipositing females or immature stages of light, shade and mechanical obstruction, water movement and silt, water temperature, dissolved oxygen, organic matter and pollution, and salt water and tidal influence.

PAPERS NOTICED BY TITLE ONLY.

LEESON (H. S.). **The recorded Distribution of the Tick** *Rhipicephalus sanguineus* **(Latreille).**—*Bull. ent. Res.* **42** pt. 1 pp. 123–124, 1 map, 5 refs. London, 1951.

KRIJGSMAN (B. J.) & KRIJGSMAN-BERGER (N. E.). **Physiological Investigations into the Heart Function of Arthropods. The Heart of** *Periplaneta americana*. —*Bull. ent. Res.* **42** pt. 1 pp. 143–155, 39 refs. London, 1951. [See *R.A.E.*, A **39** 368.]

DE ZULUETA (J.) & BATES (M.). **Laboratory Experiments with Selection of Oviposition Site by** *Anopheles darlingi*.—*Amer. J. Hyg.* **48** no. 3 pp. 350–360, 4 figs., 11 refs. Lancaster, Pa., 1948.

The following is substantially the authors' summary. Experiments on the oviposition behaviour of *Anopheles darlingi* Root in a caged colony in Villavicencio, Colombia, are described. Two peaks of egg-laying activity in the 24-hour cycle were evident, one soon after sunset and the other soon after sunrise. Females usually laid their eggs when hovering a few centimetres above the water, but a few did so when resting on the water or on the sides of the pan. When the mosquitos were given a choice of two identical pans, the distribution of the eggs laid depended on the position of the pans on the cage floor. For routine experiments, two positions that were about equally acceptable were used, and any particular type of test was carried out at least twice with the position of the test pans reversed.

Upright obstacles inside the oviposition pan repelled ovipositing females, but similar obstacles round the outside of the pan were attractive. Shade from a piece of cardboard 14 ins. above the pan was attractive. A sheet of glass at this height above a pan had no effect, but if it was 6 ins. above a pan, that pan was avoided. A pan containing only a small depth of water (one centimetre) was preferred to one that was full to the brim (4 ins.). A pan raised above floor level was avoided. Materials breaking the water surface, such as floating petri dishes, watch glasses resting on the bottom, floating blocks of wood or paper strips, generally repelled ovipositing females. When conditions on the walls of the cage were modified, a radical change in the distribution of resting mosquitos was caused, but no effect on the situation factor in the choice of an oviposition site followed.

Experiments with water from different natural breeding places and with trace amounts of different chemicals (not reported here), gave negative results that contrasted strongly with the selection behaviour noted in the experiments with physical factors. This may mean that visual orientation is also of great importance in determining the choice of oviposition sites in nature, and indicates the need for further experiments along this line with different species of Anophelines.

BONNET (D. D.). **The Distribution of Mosquito Breeding by Type of Container in Honolulu, T. H.**—*Proc. Hawaii. ent. Soc.* **13** no. 1 pp. 43–49, 4 figs., 18 refs. Honolulu, 1947.

The mosquitos that occur in Hawaii are *Aëdes aegypti* (L.), *A. albopictus* (Skuse) and *Culex fatigans* Wied. (*quinquefasciatus* auct.) *cf. R.A.E.*, B **33** 71]. A survey of potential breeding places of *Aëdes* in Honolulu made over a period of 22 months in 1944 and 1945 showed that the percentage prevalence of the various types and (in brackets) the percentage of the total number of actual breeding places of *Aëdes* represented by each were animal drinking pans 24·1 (11), bottles 20·3 (10·3), tins 11·4 (16·8), interior containers 10·9 (10·6), barrels 8·4 (10·7), ape plants (*Alocasia macrorrhiza*) 7·4 (4·1) and lily plants (including *Bilbergia thyrsoidea* and *Crinum asiaticum*) 7·1 (12·6). The remainder included tyres, ditches, cesspools, fish ponds and ant cups. It was estimated that unnecessary outdoor containers comprised 45·9 per cent. of the total and supported 55·3 per cent. of the *Aëdes* breeding. A table is given showing the percentages of *A. albopictus*, *A. aegypti* and *C. fatigans*, represented by 1,014, 922 and 924 samples, respectively, found in each of 29 types of containers or potential breeding places. Those responsible for over 10 per cent. of the breeding were tins (19·4), flower vases (13), and lily plants (10·7) for *A. albopictus*, buckets (13·7), tins (13·4), flower vases (11·9) and pans (11·6) for

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A. aegypti, and ditches and ground pools (19·7), tins (16·2), buckets (13·7) and barrels (10·1) for *C. fatigans* [*cf.* **33** 72].

Hu (S. M. K.). **Notes on the experimental Infection of *Culex pipiens* var. *pallens* Coq. with *Microfilaria malayi* Brug.**—*Lingnan Sci. J.* **22** no. 1–4 pp. 79–83, 1 ref. Canton, 1948.

Females of *Culex pipiens* var. *pallens* Coq. were allowed to feed in three batches on a patient from Chekiang Province showing large numbers of microfilariae of *Filaria* (*Microfilaria*) *malayi* in his blood and were dissected after intervals of 7–30 days. Of 242 mosquitos, 220 showed no filarial larvae, five contained infective larvae, the maximum number per mosquito being three, one contained a developing larva, and 19 contained immature larvae that were dead and completely encapsulated. As the patient was more heavily infected than the one used in a previous experiment [*R.A.E.*, B **29** 22], the results confirmed the low susceptibility of *C. p. pallens* to infection with *F. malayi*.

Mackerras (M. J.) & Mackerras (I. M.). **Notes on Australasian Simuliidae (Diptera). II.**—*Proc. Linn. Soc. N.S.W.* **75** pt. 3–4 pp. 167–187, 15 figs., 3 refs. Sydney, 1950.

These notes on observations made since the publication of the authors' previous paper on Australasian Simuliids [*R.A.E.*, B **38** 175] include a brief description of characters differentiating larvae of *Cnephia* from those of *Simulium*, keys to the adults, and larvae and pupae where known, of the species of *Cnephia* of the group of *C. aurantiaca* (Tonn.) and descriptions of them, keys to the larvae, pupae and adults of both sexes of the species of *Simulium* (except two of the New Guinea species), and descriptions of one new species of *Cnephia*, three of *Simulium* and one of *Austrosimulium*, all from Queensland, a new subspecies of *C. tonnoiri* Drummond from Tasmania, Queensland and Australian Capital Territory and the early stages and male of *S. faheyi* Tayl. Records extending the known distribution of previously described species are also given. The Queensland fauna is increased from nine species [**37** 123] to 17.

Parker (A. H.). **Observations on the seasonal and daily Incidence of certain Biting Midges (*Culicoides* Latreille—Diptera, Ceratopogonidae) in Scotland.**—*Trans. R. ent. Soc. Lond.* **100** pt. 7 pp. 179–190, 2 graphs, 11 refs. London, 1949.

The following is substantially the author's summary. Systematic collections of *Culicoides* made with a hand-net in 1947 at a site on the shore of Loch Lomond, showed the periods of occurrence of species obtained in moderate or large numbers to be June–August (with a peak in July) for *C. impunctatus* Goetg., June–September (with a peak in July) for *C. pallidicornis* Kieff., June–July (with a peak in late June) for *C. heliophilus* Edw. and May–October (with no well defined peaks) for *C. pulicaris* (L.) and *C. obsoletus* (Mg.) and the species closely allied to it (*C. chiopterus* (Mg.) and probably two others unspecified). The sex-ratios of these species were always unequal. Females were the more numerous in some species and males in others. Only *C. pallidicornis* yielded large numbers of both sexes.

Adults were obtained in greatest numbers during the evening. Apart from a slight increase at sunrise, they were almost absent at other times. The evening peak of females of *C. pallidicornis*, *C. impunctatus* and the *C. obsoletus* group and males of *C. pulicaris* was around sunset. That of males of *C. pallidicornis* and females of *C. heliophilus* was several hours earlier. The number of adults taken was much affected by wind strength, but differences

of temperature and humidity had no apparent effect. The time of evening flight, relative to sunset, tended to be earlier on darker than on lighter evenings. A series of exposures showed that females of *C. impunctatus* were much more strongly attracted to man than females of the other species. The observations made are discussed in relation to those of other investigators [*R.A.E.*, B **37** 74 ; **38** 48].

KETTLE (D. S.). **The seasonal Distribution of** *Culicoides impunctatus* **Goetghebuer (Diptera : Heleidae (Ceratopogonidae)) with a Discussion on the Possibility that it may be composed of two or more biological Races.**—*Trans. R. ent. Soc. Lond.* **101** pt. 4 pp. 125–145, 8 figs., 8 refs. London, 1950.

The following is mainly based on the author's summary. It is shown that the seasonal distribution of *Culicoides impunctatus* Goetg. in the neighbourhood of Loch Lomond, Scotland, in 1947, 1948 and 1949 was bimodal. Parker in 1947 [see preceding abstract] found only one peak in early July, but he made no observations between 3rd and 24th August when the second was noticed by another worker in the same locality. The bimodal distribution could be due to climatic factors, or might arise if *C. impunctatus* were bivoltine or consisted of two races. Consideration of climatic factors led to the conclusion that, whilst they might considerably modify the bimodal distribution, they could not, in themselves, account for it.

The evidence for and against the theory that there were two generations a year was not conclusive. However, at the end of May 1949, when pupation was nearly complete among the larvae that were to give rise to the adults that formed the first population peak (which occurred in that year in early June), larval density was still more than half what it had been originally. There were thus enough larvae in the soil to account for a second wave of emergence without the necessity of postulating a rapidly developing generation. Hill's observation in Liverpool [*R.A.E.*, B **38** 48] showed that *C. impunctatus* is incapable of the necessary rapid development. It would be unique were it bivoltine in Scotland and univoltine 200 miles further south in England. Therefore, although incomplete, the evidence indicates strongly that *C. impunctatus* is not bivoltine.

Critical examination of the pattern and length of the wings of females and the genitalia of males of *C. impunctatus* failed to reveal any morphological differences between the individuals forming the first and second population peaks in 1948. There was, however, a statistically highly significant difference between the sex ratios of the two populations. The first contained about 10 per cent. more males than the second. Also, they varied significantly, though not greatly, in horizontal and vertical distribution. These facts, in addition to the findings on larvae, justify the acceptance, as a working hypothesis, of the existence of two biological races of *C. impunctatus* at Loch Lomond.

PARKER (R. R.) & SUSSMAN (O.). **Spontaneous Infection of the Brown Dog Tick,** *Rhipicephalus sanguineus* **with** *Coxiella burnetii*.—*Publ. Hlth Rep.* **64** no. 36 pp. 1159–1160, 2 refs. Washington, D.C., 1949.

The recovery is reported of a strain of *Rickettsia* (*Coxiella*) *burneti*, the causal agent of Q fever, from a group of 18 examples of *Rhipicephalus sanguineus* (Latr.) collected in June 1948 from a dog in Arizona. Laboratory experiments by various workers, some of which have not been published, have shown that the rickettsia persists from stage to stage in this tick, and that guineapigs can be infected by its bite or by application of its faeces to the abraded or unabraded skin [*cf. R.A.E.*, B **29** 196].

Packchanian (A.). **The Fate of *Trypanosoma duttoni* in *Triatoma*.**—*Amer. J. trop. Med.* **28** no. 3 pp. 383–386, 5 refs. Baltimore, Md., 1948.

As bugs of the genus *Triatoma* can acquire trypanosomes other than *Trypanosoma cruzi* from the animals on which they feed [*cf. R.A.E.*, B **35** 124 ; **38** 164, etc.] it is important to know whether such trypanosomes will multiply and persist in them and, if so, how they can be distinguished from *T. cruzi*. Experiments with *T. duttoni*, which, like *T. cruzi*, may be found in naturally infected mice (*Mus musculus*) were therefore made, by starving nymphs of *Triatoma gerstaeckeri* (Stål) for a month, and then feeding them on heavily infected mice. The trypanosome survived in them for only 2–3 days, and no multiplication occurred. The flagellates gradually became sluggish and motionless and then disintegrated. Thus, when crithidial or herpetomonad forms are found in the gut of *Triatoma*, they indicate that the species is not *Trypanosoma duttoni*, and if the bugs were kept for three days or longer, the presence of any active trypanosomes whatever would exclude this species. Similar tests on trypanosomes found in several other rodents in the United States gave similar results, no flagellates surviving more than ten days.

Elmendorf jr. (J. E.). **Second and supplementary Report on Field Experiments to demonstrate Effectiveness of various Methods of Malaria Control.**—*Amer. J. trop. Med.* **28** no. 3 pp. 425–436. Baltimore, Md., 1948.

This supplementary report on the outcome of comparative tests of anti-malaria measures made in coastal towns in tropical America in 1945–46 [*cf. R.A.E.*, B **38** 145] includes the results of surveys made in August and December 1946, eight and twelve months, respectively, after control was instituted. The recognised vector in all the towns was *Anopheles albimanus* Wied. The parasite rates in December 1945 and December 1946 were 92·1 and 15·6 in the town in which interiors (and in some cases exteriors) had been painted or sprayed once only with 5 per cent. DDT in kerosene, 85·4 and 12·7 in the town sprayed from aircraft with 5 per cent. DDT in diesel oil at approximately weekly intervals, and 67·6 and 2·1 in the town in which the people were treated weekly with an antimalaria drug (chloroquine). The corresponding spleen rates were 94·2 and 62·5, 90·7 and 69·8 and 92·9 and 36·8. It was almost impossible to find mosquito larvae or adults after the spraying from aircraft, but this measure was very costly. It is concluded that satisfactory control of malaria may be expected as a result of painting houses once a year with 5 per cent. DDT in kerosene at 300–400 mg. DDT per sq. ft. associated with a certain amount of suppressive chloroquine administration.

Causey (O. R.) & Kumm (H. W.). **Dispersion of Forest Mosquitoes in Brazil. Preliminary Studies.**—*Amer. J. trop. Med.* **28** no. 3 pp. 469–480, 2 figs., 7 refs. Baltimore, Md., 1948.

The dispersion and flight range of forest mosquitos were studied in Minas Gerais, Brazil, in 1947 in a preliminary investigation to determine the part played by them in the spread of the virus of jungle yellow fever over open country between forests. Mosquitos marked with bronzing powder were released in a small patch of forest in a wooded area near Passos. Recaptures were made after 12 hours, near the point of liberation and in neighbouring patches of forest, the furthest of which was separated by about half a mile of open pasture. The percentages of marked mosquitos recovered were 9 of 1,670 individuals of *Haemagogus spegazzinii* Brèthes, 50 of 903 of *Aëdes leucocelaenus* Dyar & Shannon and 16 of 8,752 of other species. Almost half of the recaptures were made in the patch of release, but three individuals of *H. spegazzinii*, ten of

A. leucocelaenus and 27 of the other species were recaptured outside it, all of the first two species and 15 of the others in the furthest patch of forest, which lay to the north-west. Within the forest where releases were made, more mosquitos were recaptured in stations to the west than in stations to the east. The prevailing wind was from the south and south-east. There was no rain during the period of the experiment.

In another experiment on flight range in an area of broken woodland, *H. spegazzinii* and *A. leucocelaenus* were not available in large numbers, but an experimental vector of yellow fever, *A. scapularis* (Rond.) [*R.A.E.*, B **28** 170], was recovered at a distance of 2½ miles, and 11 days after release. Mosquitos of several other species were recaptured at distances of half a mile or more from the point of liberation.

Scott (J. A.). **Studies on the Transmission of the Filarial Worms of the Cotton Rat.**—*Amer. J. trop. Med.* **28** no. 3 pp. 481–485, 3 refs. Baltimore, Md., 1948.

The following is virtually the author's summary. A method is described for infecting groups of cotton rats [*Sigmodon hispidus*] with relatively constant numbers of *Litomosoides carinii*, all of which are of the same age. The infections were produced by exposing the cotton rats in metal tanks [*R.A.E.*, B **38** 212] to known numbers of mites [*Liponyssus bacoti* (Hirst)] of which the percentage infection had been determined. Cotton rats infected in this way are superior for chemotherapeutic studies and for studies on immunity to those taken infected in nature with various numbers of filarial worms of mixed ages. Further improvement in the method is needed, however, and to indicate possible lines of procedure, the factors in the variability observed in these experiments are analysed.

King (W. V.). **Some Results of recent Work on the newer Insecticides.**—*Amer. J. trop. Med.* **28** no. 3 pp. 487–497, 6 refs. Baltimore, Md., 1948.

The more important results obtained in a year's work at the laboratory of the Bureau of Entomology and Plant Quarantine at Orlando, Florida, and in the field are reviewed in sections dealing with personal protection against Trombiculid mites [*R.A.E.*, B **38** 30], mosquitos [**38** 99] ticks and fleas, area control of ticks [**39** 60] and Trombiculids, control of *Musca domestica* L. and mosquitos in buildings (including a discussion of strains of *M. domestica* resistant to insecticides [*cf.* **39** 61, etc.]), control of cockroaches [**38** 4], and control of mosquito and Simuliid larvae.

In tests of treated uniforms carried out by M. M. Cole and others in an area infested with *Amblyomma americanum* (L.) [*cf.* **38** 132], diethyl phthalate gave complete protection from attachments during exposures 5, 8 and 10 days after treatment, when there were 42, 30 and 8 attachments on a control subject. N-(2-chloroethyl)trichloroacetamide and 2-phenylcyclohexanol gave complete protection 3 and 4 days after application, but were much less effective in two subsequent exposures. Diethyl phthalate and 2-phenylcyclohexanol were slightly irritating to the skin. Sorbitol laurate, N-n-butylacetanilide and Thanite allowed only a few attachments. In field tests of 18 repellents applied to the skin, made in Canada by H. F. Cross and others, dimethyl phthalate and n-propyl N, N-diethylsuccinamate gave the longest protection against subarctic species of *Aëdes* and *Simulium venustum* Say [*cf.* **38** 102 ; **39** 156].

In small-plot tests by Cole in Wisconsin in 1947, DDT and chlorinated camphene [toxaphene] applied as dusts at 2 and 3 lb. per acre gave about 95 per cent. control of adults of *Dermacentor variabilis* (Say) for at least two weeks, and chlordan about 90 per cent. When emulsion sprays were applied at 2 lb.

toxicant per acre against *Trombicula splendens* Ewing (*Acariscus masoni* Ewing) in plot tests by H. K. Gouck near Orlando in June and July, chlordan and toxaphene gave more than 90 per cent. control for seven weeks, but control with BHC (benzene hexachloride) fell well below 90 per cent. after the fifth week [*cf.* **39** 72]. Dusts containing BHC and chlordan at the same dosage were considerably less effective, causing reductions above 90 per cent. for only a week or two. Toxaphene dust at 5 lb. per acre was effective over the whole observation period of eight weeks. Hexaethyl tetraphosphate at 2 lb. per acre in emulsion form was completely ineffective, but parathion as a dust gave good control in preliminary tests at 1 and 2 lb. per acre.

Several new compounds had some toxicity to *M. domestica* and mosquitos for a short time after application, and a few, mostly analogues of DDT, showed some durability. The best were parathion and methoxy-DDT (methoxychlor) each of which in laboratory tests gave results that compared favourably with DDT during the time that they were under comparative observation (about 16 weeks). Both were somewhat more effective than DDT against *Musca* and less so against *Aëdes aegypti* (L.). Parathion was outstanding among several new compounds tested as dusts against *Periplaneta americana* (L.) and *Blattella germanica* (L.) [*cf.* **38** 66]. At 0·02 per cent., it caused complete knockdown of males of *B. germanica* in three hours and complete kill in 24 hours. With chlordan, 0·1 per cent. was needed to produce an equal kill and 2 per cent. for equal knockdown. Mortality of *P. americana* was equal to that of *B. germanica* at these concentrations, but a dust containing 4 per cent. chlordan gave no knockdown in three hours, whereas 0·02 and 0·04 per cent. parathion gave 38 and 93 per cent. Parathion caused complete mortality of fourth-instar larvae of *Anopheles quadrimaculatus* Say at 0·0005 parts per million in the laboratory. About ten times as much DDT or chlordan was needed in concurrent tests. Against larvae of *Aëdes aegypti* and *Culex fatigans* Wied. (*quinquefasciatus*, auct.), the toxicity of parathion appeared to be about twice that of DDT. In preliminary field tests made by E. S. Raun against Anopheline larvae (chiefly *Anopheles crucians* Wied.) in overgrown breeding places, the average mortalities obtained with parathion in solution in fuel oil were 99·5, 98 and 92 per cent. at dosages of 0·8, 0·4 and 0·2 oz. per acre, respectively. Comparable kills with DDT were 92, 92 and 70 per cent. An important development was the control of flood-water *Aëdes* and *Aëdes* in northern latitudes by the application of larvicides to potential breeding places before they are flooded or before they thaw [*cf.* **38** 101]. In work in New Hampshire by J. B. Kindler, DDD (TDE[dichlorodiphenyldichloroethane]) proved promising against larvae of local species of Simuliids, chiefly *Simulium venustum* and *Prosimulium hirtipes* (Fries). It seemed to be somewhat more toxic than DDT to the larvae and, from the information available, is probably less toxic to fish. A five-mile section of stream was treated with DDD in an emulsion applied at five points one mile apart, the dosage being calculated to maintain a concentration of 0·2 part per million for ten minutes. A large proportion of the larvae was eliminated, and several tests on local species of fish indicated that this dosage was well below the limit of their tolerance.

CULPEPPER (G. H.). **Rearing and Maintaining a Laboratory Colony of Body Lice on Rabbits.**—*Amer. J. trop. Med.* **28** no. 3 pp. 499–504, 1 fig., 8 refs. Baltimore, Md., 1948.

A preliminary note on the rearing of *Pediculus humanus humanus* L. (*P. h. corporis* Deg.) on rabbits has already been noticed [*R.A.E.*, B **36** 48]. An account of the results obtained in a series of tests carried out on several different rabbits of ordinary mixed domesticated varieties is given in this paper. The following is almost entirely based on the author's summary. Lice were reared

successfully for 25 generations on certain rabbits. The individual rabbits differed considerably in their suitability as hosts, and of 97 tested only seven proved to be favourable at the outset. Additional favourable individuals were found among the offspring of mated favourable pairs. The length of life and fecundity of the lice on these hosts and of the lice in the original colony maintained on man appeared to be nearly equal. After ten generations on favourable rabbits, newly hatched nymphs were transferred to unfavourable rabbits, and a second colony was successfully established on them. Mortality was high during the first four generations, but length of life and egg production had become satisfactory by the end of the tenth generation. Although egg production was about a third lower than the average for lice fed on favourable hosts, it was sufficient to maintain a vigorous colony. Lice have been maintained through 15 generations on unfavourable rabbits after ten on favourable ones. Lice collected from a naturally infested man were reared for three generations on favourable rabbits and appeared to be doing as well as those from the inbred laboratory colony. When lice were compared for their susceptibility to pyrethrum and DDT, no marked differences were found between those reared on man and those reared on either favourable or unfavourable rabbits.

Busvine (J. R.). **The "Head" and "Body" Races of *Pediculus humanus* L.**—*Parasitology* **39** no. 1–2 pp. 1–16, 1 pl., 7 figs., 20 refs. London, 1948.

The evidence regarding the status of the head and body forms (*capitis* Deg. and *humanus* L.) of *Pediculus humanus* L. is summarised, and an account is given of experiments designed to clarify the relationship between them. The following is substantially the author's summary. Measurements were made of the head length, head width, total body length, antenna length and length and breadth of the third antennal segment of head and body lice from natural infestations. In all measurements except the last the means were significantly different for the two forms, but there was considerable overlap in all cases. Head lice reared continuously on the body for 43 generations (over two years) did not change systematically in size. Body lice reared under similar conditions were likewise constant. There was a highly significant difference between the mean measurements of all the samples of head lice reared for up to two years on the body when compared with those of body lice reared for a similar period in the same way. The means for lice worn for 24 hours per day were less than those for lice worn for 12 hours per day in both strains. An experiment showed that this is probably due to a difference in average temperature. The mean live weights of head and body strains were even more distinct than linear dimensions on the several occasions when these were recorded. Measurements of the dimensions of the opercula of the eggs of the two races and the numbers of air cells in them were distributed in the same way as the body measurements: that is, distinct means but overlapping individuals. Ventral abdominal muscles in wild head lice are typically confined to the fifth segment. In wild body lice, muscles are usually present in the fourth segment as well.

Hybrids (female body louse × male head louse) were fertile for several generations. In size, the F_1 generation was intermediate, but the F_2 and F_3 generations became identical with the body-louse strain. Eggs of the body strain hatched at the same time as those of the head strain, but the percentage hatch was significantly higher in the body strain. The times of moulting during development were studied in both races in relation to differing opportunities to feed (24, 12, 6 and 3 hours per day). The two strains showed very similar reactions in regard to speed of development, but throughout there was a higher preimaginal mortality in the head strain. Head lice were shown to be considerably more susceptible to starvation than body lice. If adults of the two strains are mixed, there is no tendency towards homogeneous mating. Of the mixed

matings, those between male body lice and female head lice are much more common than the reverse. When females were offered a choice of human hair, voile and tape for oviposition, head lice laid 60 per cent. of their eggs on hair, 40 per cent. on voile and none on tape whereas the corresponding percentages for body lice were 53, 28 and 19.

It is concluded that the two forms have not become sufficiently different to be regarded as separate species, but that there seem to be some genetic differences between them and, since the typical forms of body and head lice have remained recognisable since the days of Linnaeus there seem to be good practical grounds for retaining *P. h. humanus* and *P. h. capitis* Deg. as separate names for them.

ARTHUR (D. R.). **On the Egg of the Tick,** *Ixodes ricinus* **L.**—*Parasitology* **39** no. 1–2 pp. 53–60, 12 figs., 16 refs. London, 1948.

The following is the author's summary. The egg of *Ixodes ricinus* (L.) is described, and the increase in size during development is noted. It is suggested that the increase is due to the absorption of water. The egg wall consists of exo- and endochorion with a thin vitelline membrane, which becomes thicker as development proceeds and assumes a laminated appearance. The secretion layer of Gené's organ is described, and appears to function as a cement for holding the eggs together in the cluster. Chemical tests show it to be of a waxy nature.

It is deduced from experimental evidence that the egg shell is not absolutely rigid, and the weight of evidence favours the view that the shape of the egg shell is maintained by the internal pressure of the egg contents, and the elasticity of the shell.

The development processes as seen in the living egg are described. Hatching from the egg shell is brought about by a muscular force acting on a limited area at the posterior pole of the egg.

MACLEOD (J.). **The Distribution and Dynamics of Ked Populations,** *Melophagus ovinus* **Linn.**—*Parasitology* **39** no. 1–2 pp. 61–68, 4 figs., 4 refs. London, 1948.

The following is almost entirely the author's summary. Observations were made in England in 1939–42 on the distribution of adults and pupae of the sheep ked (*Melophagus ovinus* (L.)) over the body of sheep and lambs, and the seasonal changes in density and distribution were followed by a series of counts on the same 16 sheep throughout a period of 13 months. The method of assessing the adult population by counting the living keds was checked by killing and subsequently counting them and is believed to give approximately correct results. Pupal estimations by the " live-count " method gave results apparently 50 per cent. below the actual values.

The ked population builds up rapidly during late winter and early spring to a maximum in April and early May. A decline begins in May, and by June the population has decreased very considerably. During summer, the unshorn lambs show a continued decrease, which may be due in whole or in part to loss by transference to the shorn sheep. The greatest concentration during the peak infestation is on the chest, lower shoulder and lower rib wool. In winter and spring, the population is more generally distributed and may show a preference for the upper over the lower side wool. In summer, the back is practically deserted and the upper sides only sparsely populated. The throat and chest region is a favoured site all the year round, and there is some indication that the throat may be a breeding area. Generally speaking, the adult and pupal populations are proportionately distributed. In late spring, however, puparia

tend to be deposited to a greater extent, relative to the adult population, in the lower than the upper surface fleece.

The significance of the seasonal population shifts is discussed, and a method of eradicating keds from a flock by summer dipping of the lambs is outlined. The possibility of eradication is due to the fact that sheep of British breeds are completely freed from their keds when they are shorn [*cf. R.A.E.*, B **38** 80], and do not become reinfested from the lambs until their wool has grown enough to provide shelter.

ADLER (S.) & FELDMAN-MUEHSAM (B.). **A Note on the Genus *Hyalomma* Koch in Palestine.**—*Parasitology* **39** no. 1–2 pp. 95–101, 8 figs., 12 refs. London, 1948.

Examination of the laboratory-bred progeny of individual females of the genus *Hyalomma* from Palestine confirmed the extreme variability of these ticks and showed it to be possible to recognise four or five of Schulze's species or subspecies [*R.A.E.*, B **17** 112] in the progeny of a single female. A list is given of characters that were found useful for diagnosis by microscopic study. The most valuable is the shape of the female genital aperture before oviposition. Using this character and the cuticle near the stigmata, the females of Palestine species can quite easily be identified. Identification of the males is more difficult. Another important character is the number of "tunnels" in the anterior border of the scutum. Seven species are recognised with certainty in Palestine. Keys are given to the adults of both sexes of all of them. They are *H. aegyptium* (L.), a parasite of reptiles [**24** 196] also found several times on hedgehogs and once on a bird, *H. savignyi* (Gerv.), the commonest species on cattle, *H. detritum* Schulze, *H. dromedarii* Koch, *H. marginatum* Koch, *H. schulzei* Olen. and *H. impressum* Koch. The last two are rare in Palestine. *Theileria annulata* (*dispar*) is very common in cattle in Palestine, and it is thought probable that *H. detritum* is a vector, because it is similar to *H. mauretanicum* Senevet, which is a proved vector in Algeria [**20** 43].

FELDMAN-MUEHSAM (B.). **On Larvae and Nymphs of some Species of Palestinian *Hyalomma*.**—*Parasitology* **39** no. 1–2 pp. 138–147, 12 figs., 10 refs. London, 1948.

Descriptions are given of the larvae and nymphs of *Hyalomma savignyi* (Gerv.), *H. dromedarii* Koch, *H. marginatum* Koch and *H. detritum* Schulze bred from females determined as described in the preceding paper, and some information on their biology is included. The nymph of *H. aegyptium* (L.) is also described. *H. savignyi*, all stages of which occur on cattle and camels and which has occasionally been seen on goats, is distributed throughout Palestine and has a very long season. In the Jordan Valley and the Negeb, it is found on cattle during the whole winter. It was reared in the laboratory on hedgehogs. It is generally a three-host tick, but occasionally the engorged larvae remain on the host and drop only as engorged nymphs. Larvae were kept at 32°C. [89·6°F.] and about 75 per cent. relative humidity. They do not feed until they are 2–4 weeks old. On the basis of the averages obtained in the laboratory for the different stages, one generation was estimated to occupy 116 days at 32°C. It would seem that there are at least two generations a year in nature.

H. detritum is not very common in Palestine. It occurs on cattle and has been found on camels. The adults appear only in the middle of summer and not in great numbers. This species can be reared on hedgehogs and rabbits in the laboratory, and breeding experiments indicate that it is a two- and three-host tick. From a group of unfed larvae that were put on a hedgehog, 25 dropped as engorged larvae, 60 as unfed nymphs and a few as engorged nymphs.

On the basis of laboratory breeding at 32°C., one generation was calculated to occupy about 146 days, and there probably could not be more than one complete generation in a year. *H. marginatum* is very common on camels and occurs in small numbers on cattle. It was found all over Palestine from April to November. It seems to be a two-host tick. Laboratory rearing proved difficult. *H. dromedarii* is very abundant on camels and was found twice on cattle. In the south of Palestine, it was also abundant during winter. The duration of one generation and that of each stage is about the same as for *H. savignyi*, but the period between the fall of the nymphs from the host and ecdysis appears to be shorter. There are probably several generations in a year.

TATE (P.). **The Technique for breeding pure-line Cultures of the Blow-fly** (*Calliphora erythrocephala*).—*Parasitology* **39** no. 1–2 pp. 102–104, 3 figs., 2 refs. London, 1948.

In breeding pure strains of *Calliphora erythrocephala* (Mg.), stringent precautions are needed to prevent contamination by stray flies, as females oviposit near meat that they cannot reach, and the newly hatched larvae can pass through minute openings and travel long distances to reach food. A simple and convenient cage for rearing blowflies was devised and is described. It measures about $10 \times 10 \times 10$ ins. and consists of a wooden frame with a floor of zinc, sides of perforated zinc and a glass top on runners. A cotton gauze sleeve is fixed to a hole in one side. The meat used in the cage was dipped in boiling water to destroy contaminating eggs and larvae and placed in a container on a support standing in a dish of water to protect it from migrating larvae. The glass top of the cage prevented eggs laid above from falling on to it. When adult flies were kept in the cage, they were given water and moistened dextrose as well as meat. When the meat was being used for rearing larvae, it was placed on a little sawdust in a large watch-glass resting on sawdust in a bowl standing on the support. The larvae pupated in the sawdust beneath the watch-glass, and the puparia were sieved from it and were kept in fresh sawdust in glass dishes with closely fitting covers to exclude parasites. The cycle from egg to egg occupied about a month at 21°C. [69·8°F.]. A relative humidity of about 80 per cent. was satisfactory.

BUXTON (P. A.). **Experiments with Mice and Fleas. I. The Baby Mouse.**—*Parasitology* **39** no. 1–2 pp. 119–124, 2 graphs, 3 refs. London, 1948.

A fuller understanding of the feeding habits of fleas on rodents is needed for the study of the epidemiology of plague in field and laboratory. This note is concerned with experiments made between 1937 and 1939 on baby mice as hosts for *Xenopsylla cheopis* (Roths.). Work recorded in a paper already noticed [*R.A.E.*,B **27** 109] indicated that adult mice often eat many of the fleas confined with them, whereas baby mice do not. In preliminary experiments, fleas fed equally well on very young mice that were pink and unable to walk and on slightly hairy ones about ten days old and showed no decided preference between a baby mouse taken straight from its mother, and one cooled at about 20°C. [68°F.] for an hour. There was almost no mortality among fleas kept for 14 days on baby mice of various ages at 30°C. [86°F.]. When, however, the reproduction of the fleas was considered, the baby mice were not such satisfactory hosts. When fleas were fed on mice 2–4, 5–8 or 9–10 days old, the mean numbers of eggs per female were 19·3, 35 and 46 in 14 days in one series of experiments and 9·8, 23·2 and 35·2 in ten days in another, and on the younger mice, the beginning of oviposition was delayed. The mean number of eggs laid per female per day by fleas fed on the mice 9–10 days old in these tests was only 3·5–5·5, whereas fleas on an adult mouse laid enough eggs to give rise to

seven adult offspring per day. A brief single feed on an adult mouse before maintenance on baby mice sometimes increased the number of eggs laid. The progeny of fleas fed on an adult mouse emerged earlier than that of fleas fed on baby mice. A possible reason for this is the lack of mouse faeces in the jar containing the baby [*cf.* **25** 227]. It is suggested that the comparatively poor reproduction on baby mice is due to lack of a mammalian sex hormone that the fleas would normally derive from the blood of an adult mouse.

Bishop (A.) & Birkett (B.). **Drug-resistance in** *Plasmodium gallinaceum*, **and the Persistence of Paludrine-resistance after Mosquito Transmission.**—*Parasitology* **39** no. 1–2 pp. 125–137, 32 refs. London, 1948.

The experiments described include one in which a paludrine-resistant strain of *Plasmodium gallinaceum* was shown to retain its resistance to the drug after five cyclical passages through *Aëdes aegypti* (L.) occupying three months, without intervening drug treatment.

Sharif (M.). **The Water Relations of the Larva of** *Xenopsylla cheopis* **(Siphonaptera).**—*Parasitology* **39** no. 1–2 pp. 148–155, 18 refs. London, 1948.

The loss of water with the contents of the alimentary canal is very great in flea larvae, as the faeces are discharged in a semi-liquid state, owing to the absence of rectal glands to extract water from them. There is also profuse transpiration through the cuticle, and a considerable loss through the tracheal system, owing to the absence of an efficient apparatus for closing the spiracles. An account is given of experiments designed to show how the larvae of *Xenopsylla cheopis* (Roths.) gain the water needed to compensate for these losses. The tests were made at 22°C. [71·6°F.] and a relative humidity of 60 per cent. The moisture content of the food (dried horse blood and yeast) was varied by controlling the quantity available and the duration of its exposure in the experimental environment. The results, which were analysed statistically, show that the food is the main source from which the larvae gain water [*cf. R.A.E.*, B **19** 176]. The closing mechanism of the spiracles of the larva seems to play a small part in the control of evaporation at medial temperatures but none at extreme ones. The water requirements of male larvae were less than those of female larvae.

Gross (B.) & Bonnet (D. D.). **Snap Traps versus Cage Traps in Plague Surveillance.**—*Publ. Hlth Rep.* **64** no. 38 pp. 1214–1216, 2 refs. Washington, D. C., 1949.

Intensive measures for the control of rats and their fleas are carried on in the two areas of Hawaii in which plague is endemic ; they include poisoning, gassing and trapping of the rats, and applications of DDT against the fleas. At the same time, trapped rats and their fleas are regularly examined for plague infection. The advisability of using snap traps has been questioned not only because the fleas that leave the dead rats are not available for examination, but also because they might spread plague. The results obtained with 100 snap traps and 100 cage traps in one of the areas between July and November 1946 are therefore compared. Identical bait was used in the two kinds of traps. Living rodents in cage traps were gassed and placed in paper bags, and dead rodents in snap traps were first placed in paper bags, then gassed to kill the fleas on them. The snap traps were responsible for 82·4 per cent. of the catch of rats and 84·4 per cent. of the catch of mice. The percentages of rodents infested and (in brackets) the average numbers of fleas per infested

rodent were 5·5 (1·2) in the snap traps and 10·3 (1·7) in the cage traps. It thus appears that though some fleas were lost from the snap traps, 2·7 times as many infested rodents and 1·8 times as many fleas were obtained by their use. As the numbers of fleas that leave snap-trapped rats are smaller than those that leave equal numbers of poisoned rats and as all dwellings are regularly treated with DDT deposits, it is thought that the use of the more efficient snap traps does not increase the risk of plague transmission.

[Glashchinskaya-Babenko (L. V.).] **Глащинская-Бабенко (Л. В.). Chaetotaxy of the Body of the Larvae of Ticks of the Family Ixodidae and its taxonomic Significance.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **65** no. 2 pp. 245–248, 2 figs., 2 refs. Moscow, 1949.

[Lototzkiĭ (B. V.).] **Лотоцкий (Б.В.). Chaetotaxy of the Larvae of Ticks of the Genus *Dermacentor* of the Fauna of Tadzhikistan.** [*In Russian.*]—*T. c.* no. 3 pp. 389–392, 1 fig.

In the first of these papers on the chaetotaxy of the larvae of Ixodid ticks, the author describes the arrangement of the paired groups of hairs on the dorsal and ventral surfaces of the larvae, suggests a nomenclature for them and gives a table showing the numbers of hairs in the various groups on the larvae of 14 species of Ixodids in six genera. This is followed by a key to five of the species in two genera and the other four genera, based on these numbers and the relative size of the hairs. It is emphasised that the key merely illustrates specific and generic differences and cannot be used for practical identification.

The second paper contains detailed descriptions of the complete chaetotaxy of larvae of *Dermacentor marginatus* (Sulz.) and *D. daghestanicus* Olen. from Tadzhikistan and a table showing the differences between them in this and other morphological characters. The terminology used for the hairs is not that of the first paper.

[Petrishcheva (P. A.) & Grokhovskaya (I. M.).] **Петрищева (П. А.) и Гроховская (И. М.). The Burrow of the lamelliform-toothed Rat *Nesokia indica bailwardi* (Thomas) as a Site of Mass Breeding of Sand-flies (*Phlebotomus*).** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **65** no. 4 pp. 597–599, 5 refs. Moscow, 1949.

Details are given of the finding in August 1948 of 44 larvae and 125 pupae of *Phlebotomus* in the substrate taken from a burrow of *Nesokia indica* in a cave in the Karakala region of south-western Turkmenistan. The 12 adults that emerged in the laboratory were identified as *P. alexandri* Sinton and *P. caucasicus* Marz.

[Grunin (K. Ya.).] **Грунин (К. Я.). A Mistake in Instinct resulting from parasitic Castration in *Prosimulium hirtipes* Fries (Diptera, Simuliidae).** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **66** no. 2 pp. 305–307, 4 refs. Moscow, 1949.

While watching adults of *Prosimulium hirtipes* (Fries) swarming over a shallow stream in the region of Sikhoté-Alin', Soviet Far East, in June 1941, the author observed that some of the females dropped batches of eggs into the water and other adults discharged Nematodes that fell among the eggs in the water, where their larvae would be able to parasitise those of the Simuliid. Of 6 males and 69 females captured, 4 and 13, respectively, each contained a Nematode in the abdomen, and were completely castrated.

KRASTIN (N. I.). **Крастин (Н. И.). The Decipherment of the Cycle of Development of the Nematode *Thelazia rhodesi* (Desmarest, 1827), parasitising the Eyes of Cattle.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **64** no. 6 pp. 885–887, 1 ref. Moscow, 1949.

KLESOV (M. D.). **Клесов (М. Д.). Investigations on the Biology of the Nematode *Thelazia rhodesi* Desmarest, 1827.** [*In Russian.*]—*Op. cit.* **66** no. 2 pp. 309–311, 1 fig., 1 ref. 1949.

Inflammation of the eye-balls of cattle caused by *Thelazia rhodesi* is stated in the first of these papers to be common in the Soviet Union. Lack of knowledge of the intermediate host of this nematode and of the ways in which the infestation is spread has made control impossible, and investigations were therefore carried out in the region of Khabarovsk (Soviet Far East) in 1947–48. Groups of calves that were kept outdoors during the day and indoors at night became infested, but those kept indoors day and night did not, and calves with their eyes protected by special masks did not become infested in the open. This suggested that the intermediate host was a flying insect, probably a Muscid, and attention was directed to *Musca convexifrons* Thoms. which is attracted to the region of the eyes and nose on cattle. In July 1948, infective larvae of the nematode were observed issuing from flies of that species placed in warm saline, and flies dissected in August and September contained numerous encysted larvae in the abdomen and free larvae in the head and thorax. Of 44 larvae recovered, 13 continued their development in the conjunctival sacs of calves. It thus appears that larvae of *T. rhodesi* reach the infective stage in the abdominal cavity of the fly and then migrate to the head, whence they are transferred to the eyes of cattle by flies feeding on the exudate from the conjunctival sac. There were no morphological differences between larvae of *T. rhodesi* present in the sac and those removed from the flies.

An account is given in the second paper of similar investigations in the Ukraine in 1946–48, in the course of which it was found that larvae of *T. rhodesi* develop in the body cavities of *M. larvipara* Portsch. and *M. autumnalis* Deg., which transmit them to the cattle. The females of *T. rhodesi* produce larvae in the conjunctival cavities of the eyes of cattle, and the larvae pass into the exudate from the eyes and are eventually ingested by flies feeding on the exudate. Maximum infestation of the flies by *T. rhodesi* occurred in August and September, coinciding with the peak of the infestation of the eyes of cattle.

GREEN (A. A.). **The Control of Blowflies infesting Slaughter-houses. I. Field Observations of the Habits of Blowflies.**—*Ann. appl. Biol.* **38** no. 2 pp. 475–494, 26 refs. London, 1951.

The habits of the blowflies that infest slaughter-houses in Britain were studied in 1947–50 to determine the conditions under which control measures are most likely to be effective. In all, 22 slaughter-houses in 12 counties were visited, some of them many times. General conditions on slaughter-house premises are described. Flies found in such numbers as to be considered pests were *Lucilia caesar* (L.), *L. illustris* (Mg.) and *L. sericata* (Mg.), which together formed 80 per cent. of the total, *Calliphora erythrocephala* (Mg.), *C. vomitoria* (L.) and *Phormia terrae-novae* R.-D. All were found breeding profusely on slaughter-house refuse. *C. vomitoria* alone was observed breeding in tanks of blood. Adults of *Lucilia* spp. were predominant in summer and *Calliphora* early and late in the season. Weather, particularly sunshine, and the working conditions at the slaughter-house caused great and rapid changes in the number of blowflies to be seen, and the reactions of the three genera to relatively minor changes in weather conditions differed much in degree. Redistribution of populations owing to these changes was so rapid as to make difficult

the accurate assessment of degree of infestation. It was found that blowflies do not normally settle on the internal fabric of slaughter-house buildings, but tend rather to congregate on vegetation nearby, or, in the case of *Phormia*, on outside walls.

Blowflies were seen in large numbers on carcasses only when the meat was hanging in direct sunlight, but small numbers of females flew into dimly lit sheds to oviposit on the meat. Gut was apparently the most attractive material and attracted flies both for feeding and oviposition. A preference was shown for the cut surface of meat, which *Calliphora* used for oviposition but *Lucilia* apparently only for food. The kidney flap, particularly of sheep, was probably the most attractive part of the hung carcass. Liver was not attractive within three hours of slaughter, but became heavily infested with eggs if left in the hanging room longer than this.

Larvae sought the dark except for a few hours after hatching. Migration of larvae preparing to pupate took place mainly at night, even under conditions of continuous darkness. Larvae would climb in search of sufficiently dry conditions in which to pupate. The rates of breeding were recorded for the three genera when in natural competition and when breeding independently. Under both conditions, *Phormia* developed most quickly from oviposition to adult emergence and *Lucilia* next while *Calliphora* was slowest. In independent breeding at 24°C. [75·2°F.], *P. terrae-novae* developed in 13–16 days, *L. sericata* in 16·5–24·5 and *C. erythrocephala* in 18·5–26. With mixed populations in refuse, development was more rapid, probably on account of higher temperature. The larvae of *P. terrae-novae* were predacious on other species and on each other. *L. sericata* was found to oviposit and breed successfully in fermenting pig-food apparently consisting only of vegetable matter. Observations indicated that all these Calliphorids overwinter in soil as fully grown larvae, which pupate only a short while before emerging in the spring [*cf. R.A.E.*, B **37** 205–206]. Attempts to shorten the hibernation period of the larva of *L. sericata* by raising the temperature normally resulted in death. The larvae remain capable of movement during the winter and burrow deeper during frost and rise when the soil becomes waterlogged. No adults of *L. sericata* survived the winter in one experiment in an unheated shed.

The ways in which the knowledge acquired can be used in drawing up a control programme are discussed. Control inside the buildings is not practicable ; insecticide deposits on the walls would be ineffective, since the flies do not rest there and space sprays would taint the meat. Heavily poisoning the waste material on which the flies feed and oviposit cannot be recommended, because most of it is used as animal feeding stuff, and direct spraying of the material could give only temporary relief. Application of a persistent insecticide to vegetation and the outside walls on which the flies rest and to the breeding grounds before emergence might be beneficial [*cf.* **38** 181]. The only suggested method of attacking the larvae while they are feeding is to store the refuse in deep pits or bins so constructed that fresh material would be tipped on top and the old collected from the bottom. This would expose them to high fermentation temperatures and an accumulation of waste gases. Destruction of larvae migrating to pupate would be simpler and might be obtained by spraying the ground round infested material with a lasting insecticide. Trapping them in trenches containing a larvicide might be more economical and efficient, but both yards and trenches would need to be suitably constructed from concrete. Sawdust or other attractive material for pupation that could later be burnt could also be provided. The most important approach is prevention of breeding on the premises by strict attention to hygiene, particularly clearing refuse from the premises daily or at least within three days. Such measures do not eliminate infestation but tend to prevent the build-up of an endemic population by transporting infested material to other

districts, and to prevent heavy infestation. Blood, inedible meat and offal should be stored in outbuildings. The inedible offal should be kept in heavy, galvanised-iron bins with well-fitting lids. All bins should be emptied every day or every other day and should be washed before re-use. Destructible waste should be burnt daily. Edible meat and offal should be hung in shaded rooms, preferably fitted for high-speed, forced ventilation.

GREEN (A. A.). **Blowflies in Slaughterhouses.**—*J. R. sanit. Inst.* **71** no. 2 pp. 138–145, 4 figs., 6 refs. London, 1951.

Nearly all the information in this paper has been noticed from a fuller account [see preceding abstract], but a brief description is here included of an experiment in which all vegetation within 50 yards of the midden at a slaughterhouse was heavily dusted once every six weeks with 5 per cent. DDT powder, and refuse, blood tanks, heaps of hoof and horn and any other material seen to be attracting blowflies, as well as the surrounding ground and vegetation for a distance of 15 feet from the midden, were treated daily with the same powder. A very heavy infestation of blowflies was reduced to less than 5 per cent. of its original level within a week of the beginning of the experiment. Sprays of DDT wettable powder gave good results on walls where flies were observed to rest.

HARTZELL (A.), HAYNES (H. L.) & CONNOLA (D. P.). **Apparatus used in Laboratory Insecticide Tests at Boyce Thompson Institute.**—*Contr. Boyce Thompson Inst.* **15** no. 3 pp. 131–140, 3 figs., 17 refs. Menasha, Wis., 1948.

The following is substantially the authors' summary. Apparatus used in conducting insecticide tests at Boyce Thompson Institute is described and illustrated. It consists of a series of cages in a culture room for rearing insects under controlled conditions of temperature, humidity, and light, and a testing laboratory containing a combined spray and dust hood with a motor-driven turntable mounted in it. Spray apparatus and exposure chambers are also described.

DRESNER (E.). **Culture and Use of entomogenous Fungi for the Control of Insect Pests.**—*Contr. Boyce Thompson Inst.* **15** no. 6 pp. 319–335, 2 figs., 8 refs. Menasha, Wis., 1949.

Accounts are given of a technique by which *Beauveria bassiana* was cultured on vegetable media, chiefly water-soaked beans, to obtain spores in large quantities, and of experiments in which the fungus was used in the laboratory and field against insects, including several pests of plants [*cf. R.A.E.*, A **39** 439]. In laboratory experiments, late-instar nymphs of *Periplaneta americana* (L.) all died in 7, 7 and 14 days at 70–90°F. and 80–95 per cent. relative humidity following treatment by injection of a 1 per cent. suspension of the spores, feeding on rat pellets sprayed with a 1 per cent. spore suspension and dusting with spores, respectively, but larvae of *Muscina stabulans* (Fall.) feeding within a cockroach that was killed by the fungus completed their development when transferred to a fresh host. When larvae of *Culex fatigans* Wied. (*quinquefasciatus*, auct.) were kept in water containing less than 200 parts per million of an acetone extract of mycelium in bean substrate at 75–80°F., 92 per cent. died in 2–3 days. This suggested that the paralysis and death of other insects infected by the fungus may be due to the combined effects of parasitism and of a toxic constituent of the mycelium. House-flies (*Musca domestica* L.) in one cage became infected by air-borne spores, and in another

by feeding on milk contaminated with a dust of 1 per cent. spores in flour, and all died in 24 hours, but dusting pupae with the spore dust caused no decrease in adult emergence. Dusting a mash of bran and lucerne containing house-fly eggs with a 0·5 per cent. spore dust caused no noticeable decrease in the numbers that completed their development, but the adults, which were kept in the rearing chamber, laid no eggs. Dusting a moist chamber with wet filter paper on the bottom, in which the humidity was kept at condensation point, with the 0·5 per cent. spore dust caused partial or complete paralysis in 30 minutes of 200 flies liberated in it and complete knockdown with no subsequent recovery within three hours. The same experiment repeated at 70–80 per cent. relative humidity gave neither knockdown nor decrease in egg production, and it is therefore concluded that *M. domestica* is susceptible to paralysis caused by the fungus when it is in a liquid medium.

Two natural outbreaks of an entomogenous fungus affecting blowflies were observed during periods of high humidity and frequent rain with optimum temperatures for fungus development. In the first, *Empusa americana* was found on 1st July infecting *Lucilia mexicana* Macq. (*unicolor* Tns.) breeding on food droppings from mink cages at Ithaca, New York. About 60 per cent. of the flies had been killed after two weeks and almost all of them by 1st August. Hardly any were seen from 1st August to 20th September, and the absence of all other large species of saprophytic and coprophytic Diptera indicated that they may also have been controlled by the fungus. The presence of small numbers of flies, possibly migrants, and the virtual absence of maggots indicated that the fungus either produced sterility or destroyed immature stages by growing on the food droppings. The fungus was isolated and cultured on agar media. Tests with house-flies under optimum conditions showed that whereas *B. bassiana* gave 100 per cent. kill in three hours in a moist chamber and in 24 hours at 80–90 per cent. relative humidity, *E. americana* gave only 50 per cent. kill in 24 hours in the moist chamber, with the rest of the flies living for 72 hours. The second outbreak, in which the blowflies and fungus appeared to be identical with those at Ithaca, occurred in a fowl yard at Kingston, Rhode Island, after a period of weather favouring fungus development, and it is concluded that a natural outbreak requires a long period of optimum conditions for incubation of enough spores to infect an entire population. Artificial dissemination of spores before 1st July would probably have hastened control at Ithaca.

Reid (J. A.) & Hodgkin (E. P.). **The *Anopheles umbrosus* Group (Diptera : Culicidae). Part I : Systematics, with Descriptions of two new Species. Part II : Biology and Transmission of Malaria.**—*Trans. R. ent. Soc. Lond.* **101** pt. 9 pp. 281–334, 15 figs., 61 refs. London, 1950.

The *umbrosus* group as defined in this paper comprises those species of *Anopheles* in the series *Myzorhynchus* of the subgenus *Anopheles* of which the larvae lack developed palmate hairs on the abdomen or have only a few. It is a natural group of at least nine species, which have been much confused owing to the close superficial similarity of the adults, but careful examination reveals no lack of characters of specific value. In the first part of the paper by Reid, descriptions are given of the adults, pupae and larvae of seven species, with keys to them. These are *Anopheles umbrosus* Theo., *A. baezai* Gater (of which *A. gateri* Baisas is considered a synonym), *A. letifer* Sandosham, *A. roperi* sp. n. from the Malay Peninsula, Sumatra and Borneo, *A. brevirostris* sp. n. from the Malay Peninsula, *A. brevipalpis* Roper and *A. separatus* Leic. *A. hunteri* Strickl. and *A. similissimus* Strickl. & Chowd. are omitted because they are insufficiently known, but their status is discussed. The distribution of each of the seven species is given, together with notes on identity and

synonymy. Examination of the type of *A. umbrosus* confirms the conclusions of Colless, reached independently, that *novumbrosus* Strickl. is a synonym of *umbrosus*, while the species that has generally been called *A. umbrosus* in Malaya is *A. letifer* (*R.A.E.*, B **37** 146). It has been found that the shape of the pupal respiratory trumpet, in addition to being somewhat characteristic of the group, is very distinctive of each species. The pinna of the trumpet has a well-marked secondary lobe, which varies in shape from species to species and for which the name tragus is suggested. It is considered that important structural characters in the adult, larva and pupa show that *A. brevipalpis* belongs to the series *Myzorhynchus*, rather than to the series *Anopheles*. The characters of the series *Myzorhynchus* and of groups within it are discussed. The *umbrosus* group appears to be largely confined to the Malaysian part of the Oriental region (Malay Peninsula, Java, Sumatra and Borneo), where it forms an important and characteristic part of the Anopheline fauna. Only *A. baezai*, which is a coastal species breeding in brackish water, ranges widely outside the area ; it occurs sparingly in French Indo-China, the Philippines and Celebes.

Available information on the biology of members of the group in Malaya and their importance in relation to the transmission of malaria there is reviewed by Hodgkin in the second part. The larvae are found in water that is stagnant or slowly moving, usually on the acid side of neutrality, seldom exposed to full sunlight and often in jungle or under other heavy shade. The various species have preferred breeding places that result in a characteristic zonation. *A. baezai* breeds in brackish water along the coast and favours drains and pools that contain some decaying vegetation, *A. letifer* breeds in pools and drains in cultivated land on the plains, *A. umbrosus* in jungle swamp on the plains, and *A. roperi* in temporary pools in jungle and rubber estates in the foothills ; *A. separatus* is scattered throughout much of this range outside the jungle. *A. brevipalpis*, which is rare, was found breeding with both *A. letifer* and *A. umbrosus* on the coastal plain in stagnant plantation drains and in jungle. *A. brevirostris* is too little known for generalisations to be possible. The adults of the group normally rest out-of-doors but are sometimes found in houses during the day. Both *A. letifer* and *A. umbrosus* enter houses and bite freely from dusk to dawn, and the latter will attack man in daylight in the jungle. It seems probable that *A. baezai* and *A. roperi* also feed readily on man, but *A. separatus* tends to prefer animals. Evidence on the importance of the various species as vectors of malaria is reviewed and discussed. Data obtained before 1937 are difficult to interpret, owing to the confusion in nomenclature. It is concluded that *A. letifer* is an efficient vector and at present the most important species of the *umbrosus* group in Malaya. *A. umbrosus* is also an important vector, but its distribution is restricted to jungle swamp and its immediate vicinity. Though high sporozoite rates have been recorded in *A. baezai*, its status as a vector remains uncertain in the absence of confirmatory epidemiological evidence. Available information suggests that it is a vector in the few localities where it is abundant. *A. separatus* does not appear to take any part in the transmission of malaria in Malaya. Reid contributes a note on the remaining species of the group, in which the only one discussed at any length is *A. roperi*. It has been found infected in North Borneo and it seems probable on epidemiological grounds in Malaya that it is a vector where it is common.

Chow (C. Y.). **Observations on Mosquitoes breeding in Plant Containers in Yunnan.**—*Ann. ent. Soc. Amer.* **42** (1949) no. 4 pp. 465–470, 7 refs. Columbus, Ohio, 1950.

The following is almost entirely based on the author's summary. Results are given of a survey of mosquito larvae in water held by plants in the vicinity

of Chefang, Yunnan. Of the 26 species taken, 11 were found in tree holes, 18 in bamboo stumps, and four in the leaf axils of plants of five species. These mosquitos belonged to the genera *Toxorhynchites* (*Megarhinus*), *Tripteroides*, *Topomyia*, *Harpagomyia*, *Uranotaenia*, *Orthopodomyia*, *Aëdes* (*Stegomyia* and *Finlaya*), *Heizmannia*, *Armigeres* and *Culex*.

Material collected from bamboo stumps and tree holes during the dry winter season was tested for hibernating eggs. Seven species were recovered from this material, all belonging to the genus *Aëdes*.

Causey (O. R.) & Dos Santos (G. V.). **Diurnal Mosquitoes in an Area of small residual Forests in Brazil.**—*Ann. ent. Soc. Amer.* **42** (1949) no. 4 pp. 471–482, 5 figs., 3 refs. Columbus, Ohio, 1950.

The following is virtually the authors' summary. Observations on diurnal mosquitos in residual forests in the region of Passos, Minas Gerais, were undertaken as a part of a study of a region that had been invaded by jungle yellow fever ten years previously. Mosquitos were collected on human bait at ground and tree-platform levels at four stations in four different forests, during four days a week over a continuous period of 120 weeks. Hourly, weekly, monthly and seasonal records were made. Parallel meteorological data were assembled. Of the total of 73,321 mosquitos, 9,788 were *Haemagogus spegazzinii* Brèth., which was the only species of *Haemagogus*. The highest monthly rate per man hour was 17·1 for all mosquitos and 5·0 for *H. spegazzinii* in January, 1946. *H. spegazzinii* and other tree-hole breeders were fewer in number during the second rainy season, and showed evidence of being still further reduced during the first half of the third wet season, when this study was terminated. This may indicate that there exists a cycle of several years' duration in the *Haemagogus* population in addition to the usual seasonal cycle, and that these studies were undertaken on the low side of this large cycle.

Perry (W. J.). **Biological and Crossbreeding Studies on *Aëdes hebrideus* and *Aëdes pernotatus* (Diptera, Culicidae).**—*Ann. ent. Soc. Amer.* **43** no. 1 pp. 123–136, 6 figs., 14 refs. Columbus, Ohio, 1950.

The following is partly based on the author's summary. Two morphological species of mosquitos, *Aëdes scutellaris* (Wlk.) (*hebrideus* Edw.) and *A. pernotatus* Farner & Bohart with no apparent intergrades found in nature in the New Hebrides were shown to hybridise in the laboratory with great difficulty. Six females of *A. pernotatus* and 37 of *A. scutellaris* were paired with males of the other species, but all produced infertile ova, except three of the *scutellaris* females, from which hybrid larvae and adults were reared. These showed intergrading characters, mainly those of *A. scutellaris*. The larvae showed greatest variation in the sclerotic plate, which varied from an incomplete structure with rough opposing ends to a fused but deeply indented pattern ventrally. All the 18 hybrid adults were females, and they were paired with males of *A. pernotatus*. Three laid fertile eggs, and the larvae showed even greater alteration in the structure of the sclerotic plate, which varied from a fused, irregularly emarginated saddle to a wide "bridge" fusion. The pecten teeth and comb scales of some were poorly developed. Five adults were obtained, four males with a terminalia pattern similar to that of *pernotatus*, and one imperfectly developed female.

It is concluded that *A. scutellaris* and *A. pernotatus* are true morphological species, though they are closely related taxonomically and geographically,

and that hybridisation between them in nature must be rare and is not an important factor in the present evolution of the group. Their medical importance in the New Hebrides is small. *A. pernotatus* does not feed readily on man, and epidemiological studies have indicated that *A. scutellaris* is not responsible for the transmission of dengue [*cf.* *R.A.E.*, B **39** 174, etc.] or *Filaria* (*Wuchereria*) *bancrofti* on these islands.

STERNBURG (J.) & KEARNS (C. W.). **Degradation of DDT by resistant and susceptible Strains of House Flies.**—*Ann. ent. Soc. Amer.* **43** no. 3 pp. 444–458, 7 refs. Columbus, Ohio, 1950.

It has been shown that house-flies *Musca domestica* L. of a strain resistant to DDT can degrade it to the dehydrochlorinated compound, 1,1-dichloro-2, 2-bis(p-chlorophenyl)ethylene (DDE) [*R.A.E.*, B **38** 209]. Further studies on the metabolism of DDT by resistant and non-resistant flies were designed to clarify the significance of DDT-degradation in relation to the acquisition of resistance and to contribute information on the mode of action of DDT. Analysis of ether-extracts of tissue of resistant flies topically treated with DDT showed that DDE was present in most areas of the body, but was most abundant in the cuticle of the region where the application was made. Some was found in the intestinal tract. When the mouth-parts, legs and wings of resistant flies were removed before the flies were treated, detoxification of the DDT occurred in the cuticle-hypoderm of the area covered by the treatment, but neither DDT nor DDE was found in any of the internal tissues in measurable quantities nor in the intestinal tract. It is assumed therefore, that the presence of DDE in these parts in the first test was due to the flies taking up DDT orally from contaminated surfaces. Resistant flies that had received DDT orally were able to degrade it in the digestive tract, and the DDE formed there was apparently transported to all parts of the body, whereas non-metabolised DDT was retained in the tract and did not accumulate in other parts of the body. The ability of resistant flies to degrade oral dosages of DDT before any has reached a vital site thus appears to be a factor in resistance to DDT.

DDT applied to the thorax of susceptible flies from which the mouth-parts had been removed was later recovered from the external body surface and from the pooled thoracic cuticle, legs and wings. None was recovered from the internal tissues either as DDT or as a metabolite responding to the Schechter test. Substantial quantities were not recovered. It is possible that the DDT was being converted to an unknown toxic metabolite, or that it interferes with the normal metabolism of cells in the periphery of the insect causing them to secrete a toxin that is bioassayable in more centrally situated tissues and the haemolymph. An experiment showed that the loss of DDT seen after application to susceptible flies cannot be explained by the assumption that DDE is a transitory intermediate in the formation of an unknown metabolite. Demonstration of the inability of either susceptible or resistant flies to degrade bis(p-chlorophenyl) acetic acid (DDA) showed that DDA cannot be an intermediate transitory product in the metabolism of DDT by susceptible flies. In experiments *in vitro*, DDT was degraded to DDE by the cuticle-hypoderm of resistant flies but not by that of susceptible flies or by other tissues of resistant ones.

Larvae of *M. domestica* are relatively more resistant to DDT than adults, and larvae of the resistant strain can support much higher topical treatments than those of the susceptible strain without the percentage of adults produced being reduced. In experiments in which larvae were treated topically and

examined after being kept without food for various intervals, DDT was found internally in nearly all batches of larvae of both resistant and susceptible strains but DDE was found only in the resistant larvae. In them, it occurred in considerable quantity. Nearly all the DDT applied to resistant larvae could still be accounted for 20 hours after treatment, but in the case of susceptible larvae, there was a gradual and unaccountable loss of DDT between treatment and the last extractions some 26 hours later. These observations suggest that the susceptible larvae have a mechanism for metabolising DDT into a product that does not respond to the Schechter test. The fact that resistant larvae do not show a comparable unaccountable loss may be due to their ability to convert DDT to DDE before it reaches a site where it would otherwise be converted into unknown metabolites. When resistant larvae were treated topically with DDT one day before they pupated and then kept until they became adults, further evidence was obtained that degradation beyond DDE did not take place. There was no significant difference in rate of absorption of DDT by members of resistant and susceptible strains after topical treatment of the puparia, but the rate was very slow compared with that seen in larvae and adults. The pupae of the resistant strain could degrade absorbed DDT, and the DDE thus formed was retained as such. Pupae of susceptible flies were found to contain some DDE 48 hours after topical treatment of the puparia. This was the first time that DDE was recovered from susceptible strains after treatment. A subsequent experiment showed that larvae of susceptible flies can metabolise DDT to DDE by means of the digestive system. It is possible that during the transformations occurring in the pupal stage, a substance normally present only in the digestive tract is liberated into the body fluids.

GALINDO (P.), CARPENTER (S. J.) & TRAPIDO (H.). **Notes on Forest Mosquitoes of Panama. I.** *Haemagogus spegazzinii falco* **Kumm et al.,** *Haemagogus iridicolor* **Dyar,** *Anopheles* (*Lophopodomyia*) *squamifemur* **Antunes, and** *Anopheles* (*Anopheles*) *fausti* **Vargas, four new Records for the Country (Diptera, Culicidae).**—*Proc. ent. Soc. Wash.* **51** no. 6 pp. 277–278. Washington, D.C., 1949.

This is the first of a series of publications in which it is intended to record the results of intensive studies of the biology and taxonomy of the forest mosquitos of Panama undertaken in view of the finding of active cases of yellow fever in the eastern part of the country. Larvae obtained some years ago in a tree-hole in Barro Colorado Island in the Canal Zone gave rise to typical males of *Haemagogus spegazzinii falco* Kumm, Osorno & Boshell, and females were frequently encountered in the present study on a forested mountain east of Panama City at elevations of 400–2,000 ft. No larvae were found in nature, but males were obtained from eggs laid by females in the laboratory. This mosquito was definitely arboreal, fed avidly on man and was relatively common, though wherever it occurred it was greatly outnumbered by *H. equinus* Theo. and *H. lucifer* (H., D. & K.). *H. iridicolor* Dyar was reared on several occasions from larvae found in low, open tree-holes along sandy beaches on the north-western Atlantic coast. Females readily attacked man, sometimes biting in full sunlight. Four females of *Anopheles squamifemur* Antunes were taken at night near the Upper Pequení River on a white sheet reflecting the light of a bright lantern, and a single male of *A. fausti* Vargas was reared from a pupa taken from a narrow, deep tree-hole in dense forest in December, in association with *Anopheles eiseni* Coq. and *Culex browni* Komp.

HERTIG (M.) & FAIRCHILD (G. B.). **Notes on the *Phlebotomus* of Panama. V. The second Sternite as a taxonomic Character (Diptera, Psychodidae).**—*Proc. ent. Soc. Wash.* **52** no. 2 pp. 91–95, 10 figs., 1 ref. Washington, D.C., 1950.

FAIRCHILD (G. B.) & HERTIG (M.). **VI. *Phlebotomus shannoni* Dyar and related Species.**—*Ann. ent. Soc. Amer.* **43** (1950) no. 4 pp. 523–533, 36 figs., 7 refs. Columbus, Ohio, 1951.

The first of these two papers, which form part of a series on the *Phlebotomus* of Panama, consists of a discussion of the recently discovered value of the pattern, size and proportions of the second sternite in separating closely related species of *Phlebotomus* and more particularly in matching the sexes of new species.

In the second paper, the characteristics of the group of species dealt with are defined. *P. shannoni* Dyar, *P. punctigeniculatus* Floch & Abonnenc and *P. pestanai* Pereira Barretto & Coutinho agree with the definition given in both sexes. Males of *P. texanus* Dampf and *P. minasensis* Mangabeira agree, but the female of the former differs somewhat and that of the latter is unknown. *P. undulatus* sp. n. and *P. volcanensis* sp. n. are described from males from Guatemala and Panama, respectively. The former is very close to *P. shannoni*. The latter appears to belong to the group, but its position cannot be definitely determined until the female is discovered. Comparative measurements are given for the males of these two species and Panama specimens of *P. shannoni* and *P. punctigeniculatus*. *P. christophersoni* Damasceno & Causey is considered a synonym of *P. punctigeniculatus*.

DALMAT (H. T.). **Studies on the Flight Range of certain Simuliidae, with the Use of Aniline Dye Marker.**—*Ann. ent. Soc. Amer.* **43** (1950) no. 4 pp. 537–545, 1 map, 4 refs. Columbus, Ohio, 1951.

The flight-range of Simuliids was studied in 1949 in Guatemala in view of the presumed importance of *Simulium ochraceum* Wlk., *S. metallicum* Bellardi and *S. callidum* Dyar & Shann. as vectors of *Onchocerca [volvulus]* in Guatemala and Mexico [*cf. R.A.E.*, B **35** 16, 182, etc.]. Although Simuliids breed on almost all plantations where onchocercosis is endemic, there are some plantations on which adults are abundant but breeding is either absent or negligible. The conditions on one such plantation are described. It was in an exposed position at least three miles from the nearest known breeding area. The infestation was completely controlled by a single spraying of buildings, both inside and outside, and their surroundings with 5 per cent. DDT in kerosene, Simuliids being practically absent for a period during which they could have completed many generations.

The technique adopted for the investigation was to catch adults in nature, mark them with an aniline dye (Safranin Bluish), release them at the point of collection and attempt to recover them at 20 collecting stations 2·1–7·4 miles away. The dye was ground into a powder with flour (1 : 9) and a little of the powder was puffed into test tubes containing the Simuliids. The use of a solvent, composed of absolute alcohol, glycerine and chloroform (3 : 2 : 1), greatly facilitated the recognition of marked flies.

In all, 19,580 Simuliids were stained and released, and 18,707 were taken at the catching stations. Of these, 21 were stained. One was recaptured at the most distant catching station, and another had travelled 3·8 miles by the day following release. Members of each of the three species were recovered, and there was no evidence that they differed in flight capacity. In view of

the great irregularity of the terrain, the distances covered were probably much greater than is apparent.

At present, the zones of endemic onchocercosis are considered to be rather circumscribed. However, they are very similar, in conditions affecting Simuliid development, to surrounding ones where the disease is thought not to occur. The capacity of the supposed vectors for flying long distances makes the spread of the disease beyond its present boundaries appear probable.

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